WestConnex

# M4 East

## Submissions Report

Appendices

## Volume 2

December 2015

# Appendix A

## Stakeholder identification reference numbers

WestConnex

# Stakeholder identification numbers with reference to report sections

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| Approval process | 5.1.1 | 45, 104, 230, 239, 256, 268, 273, 320, 346, 417, 439, 449, 450, 465, 553, 572, 792, 841, 885, 933, 934, 1087, 1098, 1144, 1166, 1354, 1421, 1457, 1530, 1559, 1570, 1575-1578, 1584, 1605, 1608, 1662, 1685, 1691, 1692, 1698, 1731, 1732, 1741, 1760, 1842, 1873, 1876, 1883, 1889, 1891, 1892, 1901, 1905, 1906, 1913, 1915, 1926, 1939, 1954, 1956, 1961, 1963, 1968, 1970, 1971, 1979, 1989, 2002, 2005, 2007, 2017, 2018, 2022, 2024, 2050, 2056, 2067, 2095, 2096, 2103, 2104, 2108, 2117, 2118, 2131, 2145, 2177, 2290, 2298, 2325, 2341, 2363, 2367, 2424, 2459, 2556, 2789, 2858, 2885, 3059, 3084, 3144, 3148, 3152, 3203, 3253, 3260, 3270, 3278, 3279, 3295, 3906, 4589, 4731, 4763, 4766, 4767, 4809, 4819, 4820, 4846-4850, 4858, 4862, 4863, 4866, 4871, 4872; Form letter 37; Form letter 12; Form letter 13; Form letter 19; Form letter 23; Form letter 8; Form letter 33; Form letter 16; Form letter 15; Form letter 18; Form letter 50; Form letter 49; Form letter 51; Form letter 52; Form letter 31; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22 | 2107 |
| Adequacy and independence of the EIS | 5.1.2 | 6, 13, 30-32, 41, 45, 49, 111, 124, 125, 204, 230, 239, 264, 268-271, 273, 280, 346, 356, 417, 449, 450, 467, 479, 510, 552, 594, 601, 606, 633, 671, 680, 688, 785, 792, 971, 1086, 1087, 1098, 1113, 1114, 1118, 1133-1135, 1166, 1213, 1253, 1307, 1312, 1333, 1347, 1421, 1435, 1448, 1459, 1497, 1545, 1566, 1575-1579, 1584, 1585, 1589, 1591, 1593, 1595-1597, 1602-1605, 1608, 1611, 1612, 1616, 1620, 1621, 1633, 1635, 1637, 1649, 1652, 1655, 1656, 1663, 1674, 1684, 1692, 1698, 1700, 1706-1708, 1731, 1741, 1750, 1842, 1848, 1849, 1853, 1859, 1871, 1890, 1892, 1901, 1905, 1906, 1913, 1915, 1917, 1925, 1926, 1930, 1962, 1964, 1971, 1976, 1978-1980, 1986, 1988, 1989, 1999, 2002, 2005, 2007, 2018, 2022, 2024, 2050, 2056, 2067, 2095, 2096, 2099, 2100, 2102-2104, 2112, 2114, 2117, 2131, 2134, 2135, 2149, 2173, 2177, 2202, 2237, 2290, 2325, 2338, 2339, 2341, 2354, 2358, 2360, 2361, 2363, 2364, 2380, 2395, 2424, 2465, 2486, 2491, 2546, 2608, 2646, 2706, 2713, 2718, 2725, 2760, 2790, 2791, 2814, 2945, 3011, 3027, 3030, 3031, 3036, 3042, 3051, 3059, 3083, 3084, 3100, 3140, 3152, 3156, 3203, 3204, 3208, 3213, 3253, 3257, 3260, 3275, 3633, 3636, 3642, 3649, 3698, 3718, 3731, 3835, 4589, 4602, 4631, 4710, 4724, 4729, 4731, 4754, 4763, 4766, 4767, 4770, 4801, 4819, 4820, 4845, 4846-4850, 4858, 4861, 4862, 4863, 4866, 4871, 4872, 5001; Form letter 1; Form letter 6; Form letter 7; Form letter 10; Form letter 13; Form letter 12; Form letter 19; Form letter 23; Form letter 8; Form letter 40; Form letter 42; Form letter 43; Form letter 44; Form letter 45; Form letter 32; Form letter 33; Form letter 16; Form letter 15; Form letter 18; Form letter 47; Form letter 20; Form letter 50; Form letter 49; Form letter 51; Form letter 52; Form letter 38; Form letter 31; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22; Form letter 21; Form letter 34; Form letter 41; Form letter 46; Form letter 35 | 4054 |
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| Release of the strategic business case | 5.2.2 | 45, 182, 187, 204, 205, 256, 301, 302, 429, 445, 453, 466, 468, 479, 490, 491, 521, 539, 548, 590, 664, 671, 889, 1069, 1091, 1092, 1098, 1126, 1127, 1135, 1255, 1312, 1326, 1421, 1422, 1446, 1567, 1570, 1575-1581, 1584, 1589-1591, 1593, 1602, 1604, 1605, 1608, 1610-1612, 1619, 1620, 1623, 1633, 1635, 1655, 1660, 1663, 1664, 1667, 1669, 1678, 1684, 1685, 1693, 1695, 1698, 1713, 1731, 1743, 1754, 1755, 1760, 1774, 1842, 1848, 1850, 1856, 1859, 1871, 1878, 1881, 1884, 1885, 1889, 1904, 1905, 1907, 1912, 1917, 1918, 1921, 1925-1927, 1932, 1939, 1954, 1961-1964, 1967, 1968, 1976, 1978-1982, 1989, 1991, 1999, 2002, 2007, 2014, 2016, 2018, 2056, 2069, 2095-2097, 2101-2105, 2108, 2110, 2121, 2125, 2131, 2142, 2145, 2146, 2148, 2205, 2237, 2290, 2335, 2336, 2339, 2341, 2342, 2353, 2358-2361, 2363, 2364, 2377, 2424, 2448, 2509, 2561, 2587, 2620, 2624, 2651, 2663, 2731, 2733, 2735, 2753, 2769, 2791, 2895, 2945, 2947, 2985, 3061, 3101, 3129, 3148, 3162, 3191, 3259, 3273, 3303, 3312, 3344, 3378, 3379, 3402, 3608, 3622, 3642, 3663, 3664, 3671, 3755, 3830, 3845, 4589, 4598, 4718, 4763, 4766, 4767, 4787, 4791, 4800, 4802, 4809, 4810, 4820, 4847-4850, 4858, 4862, 4863, 4866, 4871, 4872, 5001, 5007; Form letter 4; Form letter 10; Form letter 13; Form letter 37; Form letter 23; Form letter 42; Form letter 32; Form letter 47; Form letter 20; Form letter 50; Form letter 49; Form letter 38; Form letter 30; Form letter 29; Form letter 25; Form letter 34; Form letter 26; Form letter 35 | 2535 |
| Project cost and funding | 5.2.3 | 31-33, 37, 42, 43, 49, 50, 61, 240, 264, 298, 333, 445, 449, 493, 563, 611, 617, 830, 885, 927, 933, 934, 944, 1086, 1089, 1095, 1118, 1144, 1166, 1193, 1230, 1232, 1421, 1448, 1545, 1579, 1595, 1608, 1619, 1621, 1623, 1660, 1662, 1667, 1698, 1754, 1863, 1868, 1892, 1904, 1918, 1921, 1922, 1939, 1961, 1962, 1968, 1999, 2002, 2013, 2015, 2020, 2022, 2024, 2038, 2069, 2099, 2103, 2104, 2146, 2148, 2177, 2250, 2335, 2347, 2363, 2401, 2433, 2442, 3056, 3101, 3146, 3287, 3329, 3334, 3607, 3614, 3615, 3645, 3666, 3678, 3745, 3768, 3777, 3787, 3789, 4589, 4594, 4688, 4756, 4766, 4767, 4794, 4802, 4805, 4845, 4846-4850, 4852, 4862, 4863; Form letter 1; Form letter 6; Form letter 7; Form letter 11; Form letter 13; Form letter 19; Form letter 23; Form letter 8; Form letter 2; Form letter 32; Form letter 16; Form letter 50; Form letter 49; Form letter 38; Form letter 30; Form letter 29; Form letter 25; Form letter 24; Form letter 22; Form letter 34 | 2021 |
| Tolling | 5.2.4 | 6, 93, 127, 204, 264, 423, 426, 583, 994, 1097, 1421, 1458, 1546, 1571, 1594, 1604, 1616, 1955, 1968, 2007, 2095, 2464, 2562, 3392, 3645, 3694, 4595, 4693, 4847-4851, 4862, 4863, 4878; Form letter 6; Form letter 7 | 89 |
| Timing and need for other WestConnex components | 5.2.5 | 2, 22, 43, 466, 531, 568, 1127, 1579, 1582, 1583, 1593, 1604, 1609, 1612, 1664, 1669, 1971, 2124, 4765, 4811, 5001; Form letter 32; Form letter 38; Form letter 34 | 45 |
| Support for the project | 5.2.6 | 15, 94, 526, 1574, 1686, 2150, 2899 | 7 |

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| Strategic alternatives | 5.3.1 | 5, 10, 13, 19, 25, 30, 31, 34, 36, 37, 42, 44, 49, 51, 52, 59, 84, 86, 126, 158, 174, 188, 189, 198, 201, 204, 230, 237, 239, 246, 252, 256, 264, 268-270, 273, 286, 290, 293, 319, 325, 330, 335, 343, 365, 369, 416, 421, 423, 427, 429, 431, 438, 445, 447, 449, 450, 465, 466, 468, 470, 475-477, 479, 482, 490, 495, 503, 511, 521, 529, 530, 561, 586, 590, 592, 595, 598, 599, 602, 604, 605, 614, 664, 671, 688, 698, 748, 765, 767, 796, 840, 865, 885, 927, 933, 934, 963, 969, 986, 998, 1001, 1016, 1019, 1020, 1029, 1060, 1066, 1075, 1085-1087, 1091, 1092, 1095-1098, 1100, 1104, 1113-1116, 1119, 1122, 1124, 1128, 1144, 1166, 1169, 1193, 1208, 1211, 1227, 1230, 1253, 1302, 1312, 1316, 1326, 1330, 1334, 1336, 1343, 1394, 1402, 1405, 1421, 1431, 1442, 1446, 1448, 1546, 1561, 1563, 1575-1579, 1581, 1583, 1585, 1586, 1589, 1592, 1593, 1596, 1597, 1603-1609, 1611, 1612, 1616, 1620, 1623, 1633-1635, 1637, 1645, 1647, 1648, 1650, 1652, 1655, 1656, 1661, 1663, 1667, 1669, 1670, 1673, 1674, 1678, 1690, 1691, 1693, 1695, 1697-1699, 1701, 1702, 1704, 1707, 1708, 1711, 1712, 1714, 1720, 1723, 1728, 1730, 1732, 1746, 1750, 1760, 1841, 1842, 1845, 1849, 1850, 1852-1856, 1859, 1860, 1863, 1867, 1871, 1873, 1878-1881, 1884, 1886, 1889, 1890, 1892, 1901, 1905, 1906, 1913, 1915, 1917, 1919, 1920, 1923, 1925, 1927-1930, 1939, 1950, 1953-1956, 1962, 1964, 1966, 1968, 1976, 1978-1982, 1984, 1985, 1987-1989, 1991, 1994, 1996, 1999, 2001, 2007, 2009, 2013, 2015, 2018, 2020, 2022, 2024, 2033, 2036, 2038, 2050, 2067, 2069, 2095, 2096, 2098, 2101, 2103-2105, 2108-2110, 2112, 2118, 2120, 2124, 2125, 2128, 2129, 2131, 2136, 2137, 2140, 2142, 2143, 2148, 2149, 2173, 2177, 2202, 2234, 2235, 2237, 2243, 2278, 2336, 2339, 2341, 2344, 2359, 2361, 2363, 2364, 2370, 2373, 2374, 2378-2380, 2399, 2402, 2407, 2411, 2416, 2418, 2428-2430, 2434, 2436, 2439, 2440, 2442-2444, 2446, 2447, 2449, 2450, 2453, 2455, 2460, 2462, 2464, 2465, 2467, 2469, 2471, 2477-2479, 2484, 2485, 2487-2490, 2492, 2493, 2495, 2499, 2501, 2502, 2504-2506, 2508-2513, 2520, 2524, 2530, 2534, 2535, 2540, 2547, 2551, 2552, 2564, 2565, 2577, 2578, 2582, 2587, 2590, 2591, 2593, 2597, 2605, 2610, 2614, 2617, 2619, 2629, 2632, 2635, 2638, 2639, 2641, 2643, 2644, 2649, 2651, 2665, 2666, 2669, 2676, 2680, 2681, 2692, 2694, 2696, 2697, 2699-2701, 2703, 2704, 2706, 2708, 2712, 2714-2716, 2720-2724, 2728, 2729, 2732, 2733, 2739, 2741, 2742, 2747, 2750, 2754, 2755, 2757, 2759, 2761, 2762, 2765, 2766, 2768, 2781, 2784, 2785, 2787, 2793, 2794, 2796-2798, 2802, 2804, 2806, 2807, 2810, 2814, 2815, 2821, 2823, 2837, 2846, 2850, 2856, 2858, 2860, 2863, 2864, 2866, 2871, 2876, 2883, 2884, 2887, 2888, 2894-2897, 2903, 2905, 2907, 2908, 2910, 2919, 2924, 2929, 2934, 2942-2944, 2946, 2949, 2952-2955, 2959, 2963-2966, 2968, 2971, 2975, 2977, 2979, 2981, 2984, 2985, 2987, 2988, 2990, 2993, 2994, 2996, 2998, 3000, 3002, 3004, 3005, 3014, 3016-3018, 3020, 3021, 3030-3032, 3035, 3037, 3041, 3043, 3044, 3046, 3048, 3049, 3056-3059, 3061, 3062, 3065, 3067-3070, 3076-3078, 3080, 3082-3085, 3089-3093, 3095, 3097-3100, 3106-3109, 3111, 3112, 3120-3122, 3125-3127, 3129, 3132, 3133, 3137, 3138, 3141, 3146, 3149, 3150, 3152-3154, 3156, 3159-3161, 3163, 3164, 3169, 3170, 3175, 3179-3182, 3185, 3186, 3188-3191, 3194-3198, 3200, 3204, 3206-3209, 3219, 3229, 3232, 3233, 3235, 3239, 3240, 3242, 3243, 3246, 3247, 3250, 3252, 3253, 3255, 3258, 3260-3262, 3264-3267, 3269, 3271, 3272, 3274, 3276, 3285, 3287, 3288, 3290, 3293, 3297, 3300, 3301, 3303, 3304, 3308, 3309, 3312, 3320, 3322, 3324, 3325, 3327, 3330, 3331, 3333, 3335, 3336, 3339, 3349-3351, 3356, 3357, 3360, 3362, 3364, 3367, 3378, 3379, 3385, 3386, 3395, 3402, 3607, 3608, 3614, 3615, 3620, 3622, 3623, 3625-3630, 3632, 3635, 3637-3645, 3648, 3652-3656, 3658, | 3478 |

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| Tender process and alternative tender designs | 5.3.3 | 490, 2101, 4878 | 3 |
| Preferred tender design refinements | 5.3.4 | 1097, 1571, 1579, 1962, 2002, 2093, 2150; Form letter 32 | 14 |
| Selection of surface infrastructure locations | 5.3.5 | 9, 26, 31, 32, 36, 37, 40, 47, 340, 1113, 1114, 1118, 1544, 1656, 1707, 1708, 1761, 1908, 3187; Form letter 1 | 390 |
| Tunnel alignment | 5.3.6 | 18, 20, 21, 23, 39, 199, 236, 271, 272, 291, 340, 346, 451, 452, 462, 470, 495, 506, 507, 556, 586, 589, 594, 1088, 1608, 1692, 1845, 1847, 1867, 1871, 1876, 1893, 1902, 1905, 1930, 1981, 2108, 2132, 2134, 2135, 2361; Form letter 33; Form letter 18 | 104 |

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| Project description | | | |
| General issues and issues relating to: project footprint, tunnels, road treatments at intersections and interchanges, | 5.4.1<br>5.4.2<br>5.4.3<br>5.4.4<br>5.4.5<br>5.4.6<br>5.4.7 | 3, 7, 8, 14, 16, 22, 26-28, 32, 40, 47, 48, 61, 105, 109, 122, 123, 161, 185, 205, 234, 236, 239, 252, 261, 267, 268, 298-300, 317, 334, 341, 346, 348, 405, 454, 455, 463, 523, 546, 586, 590, 597, 598, 603, 768, 1020, 1096, 1113, 1114, 1118, 1127, 1129, 1135, 1433, 1544, 1551, 1562, 1567, 1571, 1586, 1593, 1604, 1634, 1656, 1664, 1665, 1669, 1675, 1682, 1693, 1695, 1698, 1707, 1708, 1730, 1739, 1751, 1760, 1847, 1860, 1861, 1863, 1866, 1871, 1874, 1902, 1916, 1922, 1924, 1930, 1932, 1942, 1952, 1955, 1961, 1964, 1975, 1979, 2002, 2006, 2100, 2117, 2137, 2150, 2338, 2342, 2343, 2345, 2352, 2359, 2360, 2393, 2473, 3056, 3156, 4765, 4809, 4811, 4812, 4852, 4871, 4878, 4887, 5001, 5007; Form letter 1; Form letter 11; Form letter 26 | 517 |

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| ventilation system<br>other ancillary facilities, changes to the existing road network, pedestrian and cyclist facilities and public transport. | 5.4.8<br>5.4.9 | | |

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| Construction | | | |
| Construction program | 5.5.1 | 445, 1932; Form letter 7 | 51 |
| Construction methods | 5.5.2 | 594, 1575-1578, 1871, 1930, 2096, 2341, 4763, 4767 | 11 |
| Location and layout of construction ancillary facilities | 5.5.3 | 40, 259, 271, 460, 1360, 1575-1578, 1585, 1642, 1842, 1845, 1847, 1893, 1962, 1979, 2093, 2096, 2108, 2116, 2132, 2341, 4763, 4767 | 25 |
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| Impacts on pedestrians and cyclists during construction | 5.7.4 | 122, 204, 475, 543, 597, 598, 768, 1127, 1567, 1575-1578, 1619, 1642, 1655, 1660, 1672, 1679, 1682, 1698, 1754, 1755, 1842, 1918, 1921, 1942, 1950, 1961, 1975, 1979, 2016, 2093, 2096, 2109, 2146, 2335, 2341, 2359, 3101, 3156, 3189, 4682, 4763, 4767; Form letter 11; Form letter 32; Form letter 26 | 82 |
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| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| General health impacts | 5.10.7 | 34, 40, 45, 47, 97, 122, 124, 125, 151, 204, 265, 405, 426, 429, 451, 452, 462, 468, 489, 561, 577, 594, 673, 723, 933, 934, 1088, 1091, 1105, 1135, 1166, 1219, 1227, 1354, 1360, 1421, 1433, 1448, 1507, 1570, 1572, 1579, 1607, 1612, 1647, 1655, 1656, 1658, 1659, 1661, 1664, 1684, 1685, 1692, 1693, 1699, 1700, 1743, 1760, 1794, 1842, 1845, 1850, 1871, 1892, 1922, 1930, 1932, 1939, 1950, 1964, 1966, 1970, 1972, 1979, 1985, 1999, 2007, 2018, 2020, 2022, 2024, 2050, 2102-2104, 2118, 2125, 2131, 2142, 2144, 2148, 2177, 2202, 2335, 2339, 2363, 2364, 2463, 2532, 2619, 2639, 2719, 2762, 2894, 2908, 3063, 3071, 3094, 3098, 3101, 3105, 3138, 3145, 3149, 3189, 3203, 3377, 3843, 3851, 4623, 4628, 4661, 4720, 4755, 4766, 4767, 4809, 4811, 4820, 4845, 4847-4850, 4858, 4862-4864, 4867, 4871, 4874, 5001, 5007; Form letter 6; Form letter 7; Form letter 13; Form letter 37; Form letter 19; Form letter 23; Form letter 8; Form letter 43; Form letter 33; Form letter 50; Form letter 49; Form letter 51; Form letter 52; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22 | 1828 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Land use and property | | | |
| Property acquisition | 5.11.1 | 44, 111, 124, 125, 198, 264, 349, 352, 453, 508, 520, 541, 590, 1045, 1135, 1144, 1166, 1570, 1572, 1573, 1575-1578, 1589, 1595, 1612, 1620, 1621, 1623, 1635, 1657, 1661, 1663, 1672, 1700, 1755, 1842, 1848, 1863, 1893, 1899, 1906, 1926, 1939, 1963, 1979, 1989, 1991, 1997, 1999, 2002, 2007, 2018, 2096, 2098, 2100, 2102, 2117, 2120, 2131, 2137, 2177, 2202, 2278, 2335, 2338, 2341, 2755, 2821, 2959, 3061, 3063, 3072, 3101, 3135, 3136, 3237, 3253, 3340, 3342, 3395, 3615, 3649, 3796, 4694, 4733, 4763, 4766, 4767, 4809, 4813, 4819, 4820, 4858, 4859, 4864, 4865, 4868, 4872; Form letter 6; Form letter 7; Form letter 19; Form letter 23; Form letter 8; Form letter 32; Form letter 45; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22; Form letter 26; Form letter 35 | 1640 |
| Subsurface acquisition | 5.11.2 | 594, 1871, 1930, 2117, 4884 | 5 |
| Utility and road impacts | 5.11.3 | 281, 1135, 1562, 1866, 1975, 2117, 4620, 4864 | 8 |
| Future development impacts and opportunities | 5.11.4 | 32, 230, 231, 236, 238, 252, 268, 338, 339, 344, 445, 589, 590, 1118, 1582, 1593, 1602, 1635, 1656, 1684, 1739, 1755, 1845, 1871, 1875, 1891, 1893, 1924, 1926, 1930, 1932, 1964, 2101, 2116, 2120, 2345, 2359, 2393, 3788, 3794, 4757, 4770, 4809; Form letter 1; Form letter 5; Form letter 26 | 448 |
| Property values | 5.11.5 | 4, 9, 11, 39, 199, 204, 236, 290, 291, 451, 452, 493, 513, 594, 1052, 1097, 1120, 1129, 1135, 1144, 1546, 1562, 1570-1572, 1582, 1584, 1639, 1655, 1661, 1672, 1692, 1743, 1760, 1866, 1876, 1926, 1968, 2022, 2102-2104, 2290, 2346, 2819, 3101, 3143, 3189, 3201, 4852, 4864; Form letter 5; Form letter 13; Form letter 37; Form letter 23; Form letter 33; Form letter 50; Form letter 49; Form letter 25 | 1175 |
| Overshadowing | 5.11.6 | 40, 338, 339, 971, 1571, 1672, 1739 | 7 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Urban design and visual amenity | | | |
| Construction light spill | 5.12.1 | 40, 1584 | 2 |
| Construction visual impact | 5.12.2 | 40, 47, 445, 460, 1421, 1562, 1572, 1582, 1743, 1871, 1893, 1930, 1936, 1937, 2109, 4820, 4847-4850, 4862, 4863; Form letter 9 | 32 |
| Operational landscape character impact | 5.12.3 | 215, 426, 457, 458, 462, 971, 1045, 1421, 1612, 1656, 1702, 1733, 1734, 1842, 1871, 1890, 1893, 1924, 2009, 2117, 2345, 2706, 3105, 4711, 4809, 4819, 4847-4850, 4862-4864; Form letter 5 | 37 |
| Operational visual impact | 5.12.4 | 9, 38, 40, 47, 236, 258, 264, 272, 445, 458, 586, 971, 1135, 1360, 1448, 1546, 1562, 1571, 1572, 1608, 1661, 1699, 1842, 1847, 1868, 1871, 1883, 1893, 1902, 1924, 1930, 1936, 1937, 1962, 1979, 2009, 2098, 2102, 2108, 2149, 2345, 3208, 3304, 4767, 4809, 4864; Form letter 9 | 56 |
| Operational urban design and landscaping | 5.12.5 | 35, 38, 40, 47, 162, 198, 231, 236, 278, 344, 768, 1097, 1127, 1421, 1567, 1575-1578, 1582, 1590, 1593, 1594, 1642, 1656, 1663, 1672, 1698, 1739, 1750, 1842, 1871, 1900, 1924, 1925, 1930, 1979, 1985, 2096, 2102, 2133, 2149, 2335, 2341, 2345, 4763, 4767, 4809, 4847-4850, 4862, 4863, 4872; Form letter 5; Form letter 32; Form letter 38; Form letter 34 | 83 |
| Operational light spill | 5.12.6 | 1097, 1562, 1571, 1733, 1734, 1750 | 6 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Social and economic | | | |
| Social and community impacts | 5.13.1 | 9, 45, 54, 71, 252, 269, 280, 346, 426, 445, 462, 464, 465, 539, 565, 575, 594, 600, 601, 607, 662, 723, 738, 796, 812, 871, 933, 998, 1087, 1091, 1113-1115, 1127, 1135, 1166, 1235, 1307, 1347, 1359, 1360, 1414, 1421, 1448, 1449, 1480, 1497, 1542, 1562, 1567, 1570, 1571, 1575-1579, 1589, 1593, 1594, 1604, 1610, 1611, 1619, 1637, 1644, 1653, 1655, 1656, 1660, 1661, 1663, 1664, 1666, 1685, 1691, 1698-1700, 1702, 1707, 1708, 1730, 1739, 1741, 1743, 1754, 1760, 1774, 1842, 1845, 1866, 1868, 1871, 1889, 1891, 1899, 1902, 1906, 1912, 1918, 1921, 1927, 1930, 1939, 1950, 1961, 1966, 1970, 1971, 1975, 1976, 1978-1981, 1986, 1990, 1992, 2013, 2015, 2018, 2024, 2096, 2098, 2102, 2105, 2118, 2120, 2132, 2146, 2148, 2250, 2278, 2290, 2298, 2325, 2335, 2339, 2341-2343, 2347, 2363, 2364, 2370, 2373, 2465, 2468, 2488, 2494, 2500, 2509, 2523, 2530, 2575, 2602, 2758, 2821, 2869, 2985, 3031, 3033, 3041, 3059, 3061, 3066, 3101, 3103, 3105, 3110, 3113, 3115, 3130, 3140, 3143, 3145, 3149, 3156, 3172, 3176, 3177, 3189, 3219, 3238, 3254, 3272, 3283, 3284, 3293, 3312, 3362, 3365, 3614, 3623, 3627, 3641, 3643, 3647, 3658-3660, 3663, 3670, 3817, 3827, 3836, 3845, 3847, 3857, 3903, 4596, 4597, 4603, 4618, 4621, 4652, 4656, 4661, 4679, 4703, 4711, 4724, 4728, 4729, 4735, 4736, 4738, 4743, 4748, 4749, 4751, 4763-4765, 4767-4769, 4772, 4792, 4800, 4802, 4806, 4809, 4811, 4819, 4820, 4845, 4847-4850,4858, 4862-4864, 4866, 4871, 4872, 4874, 4884, 5001, 5004; Form letter 10; Form letter 13; Form letter 37; Form letter 12; Form letter 19; Form letter 23; Form letter 8; Form letter 32; Form letter 33; Form letter 16; Form letter 15; Form letter 18; Form letter 47; Form letter 20; Form letter 50; Form letter 49; Form letter 51; Form letter 52; Form letter 31; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22; Form letter 26 | 2425 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Construction amenity and traffic | 5.13.2 | 47, 1571, 1619, 1660, 1754, 1755, 1760, 1842, 1918, 1921, 1926, 1979, 1989, 2006, 2067, 2100, 2102, 2146, 2335, 2338, 3101, 3150, 4674, 4764, 4852, 4859; Form letter 23; Form letter 18; Form letter 26 | 304 |
| Operational amenity and traffic | 5.13.3 | 25, 37, 47, 252, 1096, 1127, 1135, 1219, 1227, 1562, 1571, 1579, 1602, 1609, 1626, 1628, 1670, 1674, 1699, 1739, 1842, 1871, 1925, 1930, 1953, 1954, 1956, 1968, 1979, 1985, 1986, 1999, 2017, 2110, 2215, 2894, 2895, 2905, 2906, 2932, 3312, 3910, 4765, 4794, 4809, 4819, 5001 | 47 |
| Impacts to economic output | 5.13.4 | 22, 25, 37, 875, 1184, 1421, 1448, 1570, 1575-1578, 1612, 1663, 1741, 1845, 1891, 1892, 1964, 1985, 1999, 2096, 2143, 2325, 2341, 3119, 4589, 4634, 4763, 4767, 4811, 4820, 4847-4850, 4862, 4863, 4866, 4872; Form letter 13; Form letter 50; Form letter 49; Form letter 27; Form letter 22 | 882 |
| Compensation | 5.13.5 | 4, 11, 29, 40, 338, 339, 451, 452, 513, 573, 575, 594, 812, 971, 1096, 1135, 1421, 1570, 1571, 1575-1578, 1593, 1612, 1616, 1619, 1639, 1642, 1652, 1655, 1656, 1660, 1661, 1669, 1754, 1760, 1845, 1859, 1866, 1891, 1913, 1915, 1918, 1921, 2096, 2102, 2116, 2140, 2143, 2146, 2149, 2335, 2341, 2363, 2364, 2394, 3156, 4630, 4763, 4765, 4767, 4809, 4847-4850, 4852, 4862-4864; Form letter 32; Form letter 18 | 80 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Soil and water quality | | | |
| Construction erosion and sedimentation | 5.14.1 | 1001, 1739, 2007 | 3 |
| Construction water quality and discharge | 5.14.2 | 812, 933, 1001, 1760, 3827, 4872; Form letter 23 | 254 |
| Operational drainage infrastructure | 5.14.3 | | 0 |
| Operational water quality, treatment and discharge | 5.14.4 | 1448, 1685, 1760, 1966, 1999, 2007, 2050, 2142, 4767, 4845, 4872; Form letter 23; Form letter 8; Form letter 30; Form letter 28; Form letter 25; Form letter 24; Form letter 22 | 592 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Contamination | | | |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Flooding | | | |
| Construction hydrology and flooding | 5.16.1 | 1421. 4847-4850 | 5 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Operational hydrology and flooding | 5.16.2 | 2006, 4845, 4852, 4862, 4863, 4872 | 6 |
| Incomplete specialist report during exhibition | 5.16.3 | | 0 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Groundwater | | | |
| Construction groundwater impacts | 5.17.1 | 1850, 1956, 1976, 1978, 1980, 2335 | 6 |
| Settlement | 5.17.2 | 39, 338, 339, 513, 594, 1111, 1120, 1129, 1661, 1692, 1739, 1922, 3184, 3697, 4864, Form letter 33 | 76 |
| Operational groundwater impacts | 5.17.3 | 594, 1421, 4847-4850, 4862, 4863; Form letter 8 | 70 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Non-Aboriginal heritage | | | |
| Direct impacts to heritage items | 5.18.1 | 151, 166, 259, 269, 396, 462, 465, 476, 490, 493, 772, 901, 933, 1127, 1129, 1420, 1421, 1448, 1604, 1638, 1641, 1653-1655, 1663, 1686, 1730, 1842, 1845, 1871, 1873, 1883, 1890, 1923, 1930, 1933, 1972, 1979, 2007, 2092, 2147, 2342, 2359, 2416, 3076, 3083, 3096, 3105, 3109, 3127, 3136, 3151, 3646, 3731, 3755, 4767, 4847-4850, 4858, 4862, 4863, 4872, 4884; Form letter 23; Form letter 32; Form letter 38; Form letter 30; Form letter 29; Form letter 25; Form letter 34; Form letter 26 | 466 |
| Impacts to heritage conservation areas | 5.18.2 | 32-34, 49, 73, 122, 162, 198, 230, 239, 246, 268, 269, 278, 290, 291, 340, 417, 429, 445, 457, 462, 475, 497, 512, 540, 545, 565, 577, 590, 756, 1087, 1089, 1091, 1096, 1098, 1113, 1114, 1118, 1119, 1127, 1166, 1264, 1307, 1421, 1507, 1542, 1570, 1579, 1585, 1593, 1612, 1633, 1640, 1641, 1647, 1655, 1656, 1664, 1684, 1685, 1698, 1700, 1705, 1707, 1708, 1724, 1731, 1741, 1755, 1760, 1774, 1842, 1860, 1871, 1883, 1922, 1923, 1925, 1927, 1930, 1933, 1939, 1956, 1964, 1968, 1971, 1974, 1979, 1981, 1992, 1999, 2002, 2007, 2009, 2024, 2098, 2102-2104, 2117, 2118, 2120, 2124, 2145, 2148, 2149, 2177, 2202, 2335, 2339, 2342, 2360, 2363, 2364, 2377, 2442, 2498, 2543, 2620, 2895, 2905, 2959, 3150, 3208, 3210, 3216, 3228, 3253, 3256, 3284, 3291, 3671, 3731, 3796, 3826, 3847, 4597, 4611, 4654, 4802, 4809, 4811, 4845, 4847-4850, 4862-4864, 5001; Form letter 1; Form letter 6; Form letter 13; Form letter 37; Form letter 12; Form letter 19; Form letter 23; Form letter 45; Form letter 32; Form letter 16; Form letter 15; Form letter 18; Form letter 50; Form letter 49; Form letter 51; Form letter 52; Form letter 30; Form letter 29; Form letter 28; Form letter 27; Form letter 25; Form letter 24; Form letter 22; Form letter 26 | 2404 |
| Potential indirect impacts | 5.18.3 | 594, 1421, 1842, 1979, 2124, 2342, 3711, 4809, 4847-4850, 4862, 4863 | 14 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Biodiversity | | | |
| Vegetation clearing | 5.19.1 | 490, 772, 934, 1050, 1087, 1135, 1166, 1347, 1360, 1421, 1575-1579, 1594, 1604, 1612, 1632, 1647, 1674, 1685, 1741, 1760, 1842, 1850, 1871, 1924, 1930, 1979, 1999, 2020, 2096, 2098, 2102-2104, 2109, 2118, 2202, 2335, 2339, 2341, 2345, 2509, 2622, 3103, 3236, 3253, 3731, 3847, 4632, 4763, 4767, 4820, 4847-4850, 4862, 4863, 4866, 4872, 5001; Form letter 12; Form letter 8; Form letter 16; Form letter 15; Form letter 18; Form letter 38; Form letter 30; Form letter 29; Form letter 27; Form letter 25; Form letter 24; Form letter 22; Form letter 21; Form letter 34 | 762 |
| Impacts to endangered ecological species and communities | 5.19.2 | 772, 1421, 1575-1578, 1685, 1760, 2005, 2007, 2050, 2096, 2102, 2335, 2341, 2472, 3210, 3212, 3215, 3233, 3236, 3240, 3253, 4763, 4767, 4820, 4845-4850, 4862, 4863, 4872; Form letter 19; Form letter 23; Form letter 44; Form letter 31; Form letter 30; Form letter 29; Form letter 27; Form letter 25; Form letter 24; Form letter 22 | 667 |
| Impacts on aquatic environment and groundwater dependent ecosystems | 5.19.3 | 772, 1366, 1421, 1685, 2110, 2335, 3236, 3253, 4847-4850, 4862, 4863, 4872; Form letter 25; Form letter 24; Form letter 22 | 261 |
| Indirect and other impacts | 5.19.4 | 594, 772, 3236, 4846, 4872 | 5 |
| Biodiversity management | 5.19.5 | 475, 514, 772, 1575-1578, 2020, 2096, 2341, 2694, 3224, 3236, 4763, 4767, 4872 | 16 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Greenhouse gas | | | |
| Construction greenhouse gas emissions | 5.20.1 | 815, 1592, 1939, 1976, 1978, 1980, 2443, 3731, 4865 | 9 |
| Operational greenhouse gas emissions | 5.20.2 | 19, 252, 595, 723, 815, 933, 1354, 1421, 1448, 1467, 1592, 1611, 1616, 1650, 1685, 1701, 1753, 1842, 1849, 1853, 1884, 1886, 1939, 1956, 1968, 1969, 1979, 1985, 1999, 2005, 2007, 2022, 2101, 2125, 2142, 2336, 2443, 2497, 2516, 2517, 2524, 2525, 2530, 2581, 2619, 2669, 2703, 2739, 2782, 3031, 3104, 3145, 3159, 3214, 3253, 3268, 3299, 3350, 3644, 3723, 3731, 3821, 3825, 3833, 4608, 4766, 4767, 4794, 4819, 4845, 4846, 4861, 4865, 4867, 4872; Form letter 8; Form letter 30; Form letter 28; Form letter 24; Form letter 46 | 271 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Aboriginal heritage | | | |
| Potential impacts to Aboriginal heritage items | 5.21.1 | 2091, 2974 | 2 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Resource use and waste | | | |
| Construction spoil management and waste | 5.22.1 | | 0 |
| Other construction waste | 5.22.2 | 489, 1421, 1932, 3203, 4847-4850, 4862, 4863, 4871 | 11 |
| Construction resource use | 5.22.3 | | 0 |
| Operational resource use | 5.22.4 | | 0 |
| Peak oil | 5.22.5 | 256, 1321, 1891, 2022, 3328, 4594, 4851, 4865 | 8 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Climate change | | | |
| Climate change risk assessment and impacts | 5.23.1 | | 0 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Hazard and risk | | | |
| Construction tunnelling risks | 5.24.1 | | 0 |
| Electric and magnetic fields | 5.24.2 | 9, 1964 | 2 |
| Incidents in the tunnel | 5.24.3 | 1604 | 1 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Cumulative impacts | | | |
| Impacts of non-WestConnex projects | 5.25.1 | 264, 1663, 1894, 1971, 2920 | 5 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| Sustainability | | | |
| Sustainability of the project including use of energy from sustainable resources | 5.26 | 1609, 1647, 1662, 1713, 1920, 1966, 2418, 2424, 2432, 2522, 2762, 3036, 3222, 3300, 3657, 3706, 3721, 4799, 4845, 4863; Form letter 30; Form letter 28; Form letter 24 | 124 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| 5.27 Issues outside the scope of the project | | | |
| Voluntary (wanted) additional acquisition | 5.27.1 | 32, 40, 47, 114, 225, 230, 268, 559, 1113, 1114, 1118, 1562, 1572, 1656, 1672, 1707, 1708, 1902, 2116, 2359, 2393, 4611, 4864; Form letter 1 | 392 |
| Issues which are not part of the scope of the project | 5.27.2 | 10, 22, 23, 61, 69, 70, 72, 92, 106, 110, 194, 208, 236, 258, 267, 269, 271, 272, 290, 312, 340, 376, 384, 387, 388, 408, 423, 439, 470, 512, 521, 522, 529, 547, 571, 586, 590, 594, 618, 764, 1096, 1135, 1421, 1570, 1606, 1609, 1610, 1684, 1685, 1731, 1733, 1734, 1842, 1876, 1899, 1964, 2102, 2308, 2384, 2489, 2563, 2627, 2763, 3377, 3734, 3755, 4702, 4809, 4819, 4820, 4845-4850, 4853, 4858, 4862, 4863, 4866, 4878; Form letter 5 | 87 |

| Issue | Report section | Stakeholder identification numbers | Count |
|---|---|---|---|
| 5.28 Issues not related specifically to the M4 East project but which form part of WestConnex | | | |
| Issues related to other WestConnex projects, including: M4 Widening, King Georges Road interchange upgrade, New M5 and M4-M5 Link | 5.28 | 6, 10, 41, 333, 432, 457, 476, 495, 499, 535, 559, 590, 636, 673, 697, 772, 824, 830, 836, 901, 916, 986, 1067, 1091, 1099, 1145, 1208, 1302, 1310, 1336, 1394, 1421, 1579, 1604, 1618, 1642, 1662, 1761, 1865, 1899, 1964, 1973, 1986, 1995, 2012, 2023, 2102, 2110, 2119, 2173, 2189, 2358, 2361, 2457, 2482, 2490, 2515, 2526, 2528, 2724, 2763, 2912, 2965, 2970, 2972, 2980, 3010, 3035, 3042, 3047, 3050, 3098, 3126, 3128, 3140, 3170, 3174, 3178, 3202, 3204, 3209, 3218, 3228, 3248, 3263, 3268, 3271, 3424, 3626, 3628, 3637, 3827, 3838, 3839, 3841, 3842, 3849, 4591, 4595, 4634, 4643, 4647, 4652, 4653, 4671, 4685, 4747, 4749, 4846-4850, 4862, 4863; Form letter 13; Form letter 37; Form letter 15; Form letter 50; Form letter 49; Form letter 44 | 877 |

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# Appendix B

Assessment of significance of the Wallangarra White Gum

WestConnex

# Assessments of significance for the Wallangarra White Gum

| **Wallangarra White Gum *Eucalyptus scoparia* (Endangered – TSC Act)** |
| --- |
| *i) How is the project likely to affect the lifecycle of a threatened species and/or population?* |
| a) displaces or disturbs threatened species and/or populations; |
| The Wallangarra White Gum is known from only three locations near Tenterfield, including Bald Rock National Park. It occurs in open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes.<br>The Wallangarra White Gum is a commonly planted street tree in the Sydney area. The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. These trees occur over a mown grass park where there is no opportunity for seedlings to establish and to mature. As such, no recruitment is occurring.<br>The project would remove one planted individual. Other planted individuals occur in Reg Coady Reserve and elsewhere throughout Sydney. |
| b) disrupts breeding cycle; |
| The specimen in the project area and elsewhere in Reg Coady Reserve are planted, and do not occur in natural habitat, and are outside the natural range of the species. These trees occur in a mown grass park where there is no opportunity for seedlings to establish and to mature. As such, no recruitment is occurring. |
| c) disturbs the dormancy period; |
| This species does not have any known dormancy periods that would be affected by the project. |
| d) disrupts roosting behaviour; |
| Not applicable to this species. |
| e) changes foraging behaviour; |
| Not applicable to this species. |
| f) affects migration and dispersal ability; |
| The project will not result in any barrier to dispersal ability for this species within the highly modified landscape context of the study area. As noted above, no recruitment of these trees was observed. These trees occur in a mown grass urban park. The removal of one planted individual will not affect the dispersal ability of the species. |
| g) disrupts pollination cycle; |
| The Wallangarra White Gum is a commonly planted street tree in the Sydney area. The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. Pollinators of eucalypts include birds and bats; wind and self-pollination. The removal of a small area of planted trees would not create a barrier to the movement of birds and bats in the area, or affect wind or self-pollination. The loss of one tree would not disrupt the pollination cycle of the planted population. The loss of one tree would not disrupt the pollination cycle of the planted population. |
| h) disturbs seedbanks; |
| As described above, the Wallangarra White Gum has been planted in an urban park with a mown understory. There is likely to be minimal seedbank at the site. The loss of a small area of Reg Coady Reserve would not disturb the seedbank for this population. |
| i) disrupts recruitment (i.e. germination and establishment of plants); |
| As described above, the Wallangarra White Gum has been planted in an urban park with a mown understory. There is currently no opportunity for seedlings to establish and to mature. The loss of one planted tree would not disrupt recruitment. Recruitment in this population currently relies on planting of trees outside their natural range. |
| j) affects the interaction between threatened species and other species in the community (egg pollinators, host species, mychorrizal associations); |
| The Wallangarra White Gum has been planted in an urban park with a mown understory. The loss of a small area of Reg Coady Reserve would have a negligible effect on the interaction between this species and other species in this modified urban environment. |
| *ii) How is the project likely to affect the habitat of a threatened species, population or ecological community?* |
| a) disturbs any permanent, semi-permanent or ephemeral water bodies; |

| **Wallangarra White Gum *Eucalyptus scoparia* (Endangered – TSC Act)** |
|---|
| There are no natural watercourses near the planted Wallangarra White Gum. The nearby Iron Cove Creek runs through a concrete canal. |
| b) degrades soil quality; |
| The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. The disruption of soils as a result of construction is not likely to impact the planted specimens located near the project footprint. |
| c) clears or modifies native vegetation; |
| There would be no clearing or modification of natural habitat for this species as a result of the project. |
| d) introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread; |
| The study area is highly modified and developed and weed and exotic species are present throughout the study area and project footprint. The majority of exotic species within the study area exist as planted specimens in private gardens as well as landscaped varieties in open space and parklands. Weed species have been recorded throughout the study area and during construction there is potential for weeds to be further spread via earthworks and clearing activities, from seeds and other propagules in the soil and on vegetative material. Standard industry mitigation measures to minimise the spread of weeds are recommended as part of the project.<br>The project is not likely to introduce feral animals or vermin to the area or encourage the spread of feral animals or vermin. |
| e) removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat; |
| Not applicable for threatened flora assessment. |
| f) affects natural revegetation and recolonisation of existing species following disturbance. |
| The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. Planted specimens at Reg Coady Reserve occur over a mown grass lawn. There is no opportunity for establishment of new saplings. Recruitment in this population currently relies on planting of trees outside their natural range. As such, the project would not affect natural revegetation or recolonization of this species. |
| *iii) Does the project affect any threatened species or populations that are at the limit of its known distribution?* |
| The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted trees located hundreds of kilometres outside the natural range of the species. |
| *iv) How is the project likely to affect current disturbance regimes?* |
| a) modifies the intensity and frequency of fires; |
| There is no natural fire regime as the trees are located in a managed urban reserve. |
| b) modifies flooding flows; |
| There are no natural watercourses near the planted Wallangarra White Gum. The nearby Iron Cove Creek runs through a concrete canal. Any impact on flooding flows along the canal would not impact individuals planted in Reg Coady Reserve. |
| *v) How is the project likely to affect habitat connectivity?* |
| a) creates a barrier to fauna movement; |
| Not applicable for threatened flora assessment. |
| b) removes remnant vegetation or wildlife corridors; and |
| The Wallangarra White Gum individual to be removed is located on the edge of an urban park, adjacent to a heavily trafficked main road. No remnant vegetation would be removed at this location. Dobroyd Parade is a heavily trafficked arterial route, and vegetation to be removed is located immediately adjacent to this road. This habitat is in low condition, is not floristically diverse and has limited structure. Fauna species that would rely on this habitat would be mobile species, and this habitat is not important for maintaining local populations. Other stepping stone habitat would remain along Dobroyd Parade and in Reg Coady Reserve. Given the high risk of mortality relating to this road, the vegetation to be removed at this location it is not likely to provide important linkages for fauna. |
| c) modifies remnant vegetation or wildlife corridors. |
| No remnant vegetation would be modified at this location. Planted vegetation would be removed, and would reduce some stepping stone habitat for highly mobile fauna species. A loss or modification of a small area of habitat for planted trees would not affect the movement of pollinators in the area. |

| **Wallangarra White Gum *Eucalyptus scoparia* (Endangered – TSC Act)** |
|---|
| *vi) How is the project likely to affect critical habitat?* |
| a) removes or modifies key habitat features |
| The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. No key habitat features for the species are present in the project footprint. |
| b) affects natural revegetation or recolonisation of existing species following disturbance |
| There is currently no opportunity for recruitment of this species. The Wallangarra White Gum is present at Reg Coady Reserve as it was planted there. The specimen in the project area and other individuals elsewhere in Reg Coady Reserve do not occur in the natural habitat of the species, and are outside the natural range of the species, and thus could not recolonise existing natural potential habitat for the species. Planted specimens at Reg Coady Reserve occur over a mown grass lawn. Recruitment in this population currently relies on planting of trees outside their natural range. As such, the project would not affect natural revegetation or recolonization of this species. |
| c) introduces weeds, vermin or feral species |
| This species can be threatened by the presence of weed species and being out-competed by more vigorous exotic species. Reg Coady Reserve is an urban park located in a highly urbanised environment with many weeds and no stands of naturally occurring vegetation. The project is highly unlikely to involve the introduction or spread of weeds into areas of habitat for this species. Mitigation measures are proposed to minimise the risk of weeds being transferred as a result of the proposal. The project is unlikely to result in the introduction of feral species of any relevance to this species. |
| d) generates or disposes of solid, liquid or gaseous waste; |
| Construction of the project will result in the production of spoil from tunnelling activities and associated construction processes. Standard industry measures to manage the appropriate disposal and storage of any such waste will be adopted for the project. No waste would be deposited in Reg Coady Reserve. |
| e) uses pesticides, herbicides, other chemicals |
| Various chemicals may be used in the construction process however none are likely to result in any impact to this species. Standard industry measures relating to the storage, handling and use of chemicals and pesticides will be adopted for the life of the project. |
| *Conclusion* |
| In summary, the project is unlikely to have a significant impact on the Wallangarra White Gum as:<br>• The one individual to be removed is a planted specimen<br>• The project would not remove any natural habitat of the species as it is located hundreds of kilometres outside the natural range of the species<br>• The planted specimen to be removed is located in an urban park over a mown understory, where there is unlikely to be a viable seedbank and there is no opportunity for natural recruitment<br>• The project would have a negligible effect on potential pollinators for this species given the existing highly modified urban environment and that stepping stone habitat will remain through the locality<br>• Other planted individuals would be retained within Reg Coady Reserve. |

| **Wallangarra White Gum *Eucalyptus scoparia* (Vulnerable – EPBC Act)** |
|---|
| According to the DotE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: |
| *Lead to a long-term decrease in the size of an important population of a species* |
| An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>The population within Reg Coady Reserve does not qualify as an important population based on any of these criteria. The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. The loss of one planted individual would not lead to a long-term decrease in the size of an important population of the species. |
| *Reduce the area of occupancy of an important population* |
| The Wallangarra White Gum is native to northern NSW and southern Queensland. As described above, planted individuals in Sydney do not constitute an important population of the species. The loss of a small area of an urban park and one planted individual would not therefore reduce the area of occupancy of an important population of the species. |
| *Fragment an existing important population into two or more populations* |
| As described above, planted individuals in Sydney do not constitute an important population of the species. The project would remove a small area of planted vegetation from along Dobroyd Parade, including one individual of this species. The loss of one planted individual and a very small area of planted vegetation would not fragment an existing important population. |
| *Adversely affect habitat critical to the survival of a species* |
| No critical habitat has been listed for this species. Important habitat for this species includes open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes in northern NSW. No such habitat is present in the project footprint. The loss of a small area of planted vegetation from an urban park in Sydney would not affect any habitat critical to the survival of the species. |
| *Disrupt the breeding cycle of an important population* |
| As described above, planted individuals in Sydney do not constitute an important population of the species. The Wallangarra White Gum is a commonly planted street tree in the Sydney area. The specimen in the project area and other individuals elsewhere in Reg Coady Reserve are planted, do not occur in the natural habitat of the species, and are outside the natural range of the species. These trees occur over a mown grass park where there is currently no opportunity for seedlings to establish and to mature. As such, no reproduction is occurring in this population. The loss of one tree would not disrupt the breeding cycle of an important population of the species. |
| *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline* |
| The Wallangarra White Gum is planted in an urban park in Sydney. This park consists of scattered trees over a mown grass lawn. The loss of a small area of planted trees and shrubs would not modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species in Sydney. There would be no impact on the natural habitat of this species, which is located in northern NSW. |
| *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat* |
| The study area is highly modified and developed and weed and exotic species are present throughout the study area and project footprint. The majority of exotic species within the study area exist as planted specimens in private gardens as well as landscaped varieties in open space and parklands. Weed species have been recorded throughout the study area and during construction there is potential for weeds to be further spread via earthworks and clearing activities, from seeds and other propagules in the soil and on vegetative material. Standard industry mitigation measures to minimise the spread of weeds are recommended as part of the project.<br>The project is not likely to introduce feral animals or vermin to the area or encourage the spread of feral animals or vermin. |
| *Introduce disease that may cause the species to decline* |
| The project would not introduce disease that may cause the species to decline. |
| *Interfere substantially with the recovery of the species* |

| **Wallangarra White Gum *Eucalyptus scoparia* (Vulnerable – EPBC Act)** |
| --- |
| The project would remove one planted individual, located many hundreds of kilometres outside the natural range and habitat of the species. The loss of one planted individual would not interfere with the recovery of the species. |
| *Conclusion* |
| In summary, the project is unlikely to have a significant impact on the Wallangarra White Gum as:<br>• The population within Reg Coady Reserve does not qualify as an important population based on any of the criteria for important populations<br>• The one individual to be removed is a planted specimen<br>• The project would not remove any natural habitat of the species as it is located hundreds of kilometres outside the natural range of the species<br>• The planted specimen to be removed is located in an urban park over a mown understory, where there is unlikely to be a viable seedbank and there is no opportunity for natural recruitment<br>• The project would have a negligible effect on potential pollinators for this species given the existing highly modified urban environment and that stepping stone habitat will remain through the locality<br>• Other planted individuals would be retained within Reg Coady Reserve. |

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# Appendix C

## Traffic and transport assessment of design changes

WestConnex

# Roads and Maritime Services

WestConnex M4 East

Traffic and transport assessment of design changes

December 2015

**Prepared for**

Roads and Maritime Services

**Prepared by**

*AECOM Australia*

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# Contents

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# 1 Introduction

## 1.1 Overview of the project

Sydney Motorway Corporation (SMC), on behalf of the NSW Roads and Maritime Services (Roads and Maritime), is seeking approval to upgrade and extend the M4 Motorway from Homebush Bay Drive at Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield, in inner western Sydney. These proposed works are described as the M4 East project (the project).

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). The project was declared by the Minister for Planning to be state significant infrastructure and critical state significant infrastructure and an environmental impact statement (EIS) was therefore required.

An EIS was prepared for the project and was submitted in September 2015. The EIS and the associated specialist studies were then placed on public exhibition for a 55 day period, during which time the community and stakeholders were invited to make comments on the project and the EIS.

The project is a component of WestConnex, which is a proposal to provide a 33 kilometre motorway linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct. The location of WestConnex is shown in **Figure 1.1**. The individual components of WestConnex are:

- M4 Widening – Pitt Street at Parramatta to Homebush Bay Drive (planning approval granted and under construction)
- M4 East (the subject of this report)
- New M5 – King Georges Road at Beverly Hills to St Peters (EIS currently on public display)
- King Georges Road Interchange Upgrade (planning approval granted)
- M4–M5 Link – Haberfield to St Peters, including the Southern Gateway and Southern Extension (undergoing concept development).


**Figure 1.1** **WestConnex**

Separate planning applications would be lodged for each individual component project. Each project would be assessed separately, but the impacts of each project would also be considered in the context of the wider WestConnex.

The NSW Government initially established the WestConnex Delivery Authority (WDA) to deliver WestConnex. WDA was established as an independent public subsidiary corporation of Roads and Maritime and was project managing the planning approval process for the project on its behalf.

Since June 2015, the project delivery functions of WDA have been under transfer to SMC, following a decision to evolve WestConnex governance into a single decision-making entity. The transfer of functions was completed on 30 September 2015.

SMC is a corporation established under the *Corporations Act 2001* (Commonwealth) with a majority independent board of nine directors. The NSW Roads Minister and NSW Treasurer are joint shareholders. It is a public financial enterprise established by regulation.

Notwithstanding this, for the purpose of the planning application for the M4 East project, Roads and Maritime is the proponent.

## 1.2 Project location

The project is located in the inner west region of Sydney within the Auburn, Strathfield, Canada Bay, Burwood and Ashfield local government areas (LGAs). The project travels through 10 suburbs: Sydney Olympic Park, Homebush West, Homebush, North Strathfield, Strathfield, Concord, Burwood, Croydon, Ashfield and Haberfield. The location of the project is shown in **Figure 1.2**.

The project is generally located within the M4 and Parramatta Road corridor, which links Broadway at the southern end of the Sydney Central Business District (CBD) and Parramatta in Sydney's west, about 20 kilometres to the west of the Sydney CBD. This corridor also provides the key link between the Sydney CBD and areas further west of Parramatta (such as Penrith and western NSW).

The western end of the project is located at the interchange between Homebush Bay Drive and the M4, about 13 kilometres west of the Sydney CBD. The project at this location would tie in with the M4 Widening project in the vicinity of Homebush Bay Drive. The tunnels which form part of the project would dive from the centre of the M4, west of the existing pedestrian footbridge over the M4 at Pomeroy Street, and would continue under the northern side of the existing M4 and Parramatta Road, before crossing beneath Parramatta Road at Broughton Street, Burwood. The tunnels would continue under the southern side of Parramatta Road until the intersection of Parramatta Road and Wattle Street at Haberfield. Ramps would connect the tunnels to Parramatta Road and Wattle Street (City West Link) at the eastern end of the project. The tunnels would end in a stub connection to the possible future M4–M5 Link (which is subject to planning approval), near Alt Street.

The project would include interchanges between the tunnels and the above ground road network, along with other surface road works, at the following locations:

- M4 and Homebush Bay Drive interchange at Sydney Olympic Park and Homebush
- Powells Creek, near George Street at North Strathfield
- Queen Street, near Parramatta Road at North Strathfield (cycleway access)
- M4 and Sydney Street, Concord Road and Parramatta Road interchange at North Strathfield
- Wattle Street (City West Link), between Parramatta Road and Waratah Street at Haberfield
- Parramatta Road, between Bland Street and Orpington Street at Ashfield and Haberfield.

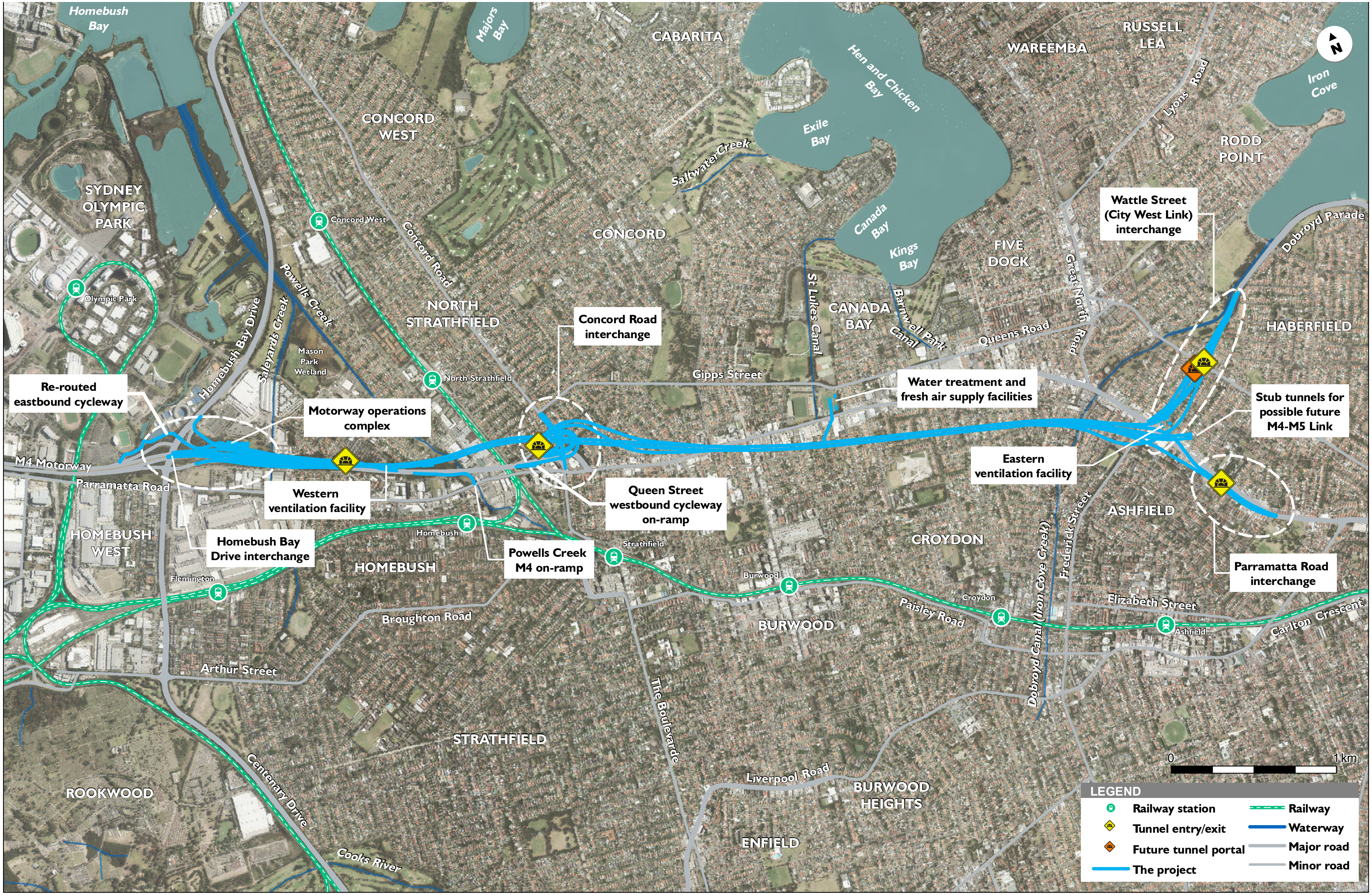


**Figure 1.2 Project location**

## 1.3 Purpose of this report

This report has been prepared to outline and assess the impact of alternative design options that have been identified since the exhibition of the EIS. As outlined in section 5.1 of the EIS, the project description was based on the preliminary concept design and would be refined during detailed design. The EIS notes that the final design of the M4 East project that is built could therefore vary from its description in the EIS.

This report assesses the traffic and transport impacts of the alternative design options, as described in **section 2**.

## 1.4 Assessment methodology

The methodology used to complete this traffic and transport assessment of design changes is the same as the approach used for the original assessment. Section 4 of Appendix G: traffic and transport assessment of the EIS provides further details of the assessment methodology and assumptions.

# 2 Proposed design changes

## 2.1 Homebush Bay Drive civil site (C1) expansion

It is proposed to expand the construction footprint at the Homebush Bay Drive civil site (C1) to the north, beyond that shown in Figure 5.29 on page 5-58 of the EIS. The affected land is owned by Ausgrid and is currently used for the following:

- Transmission line easement to the Mason Park Substation
- Hardstand car park area which is currently disused but has been previously used by the adjacent Direct Factory Outlet as an overflow car park.

The change to the construction footprint is shown in **Figure 2.1**. This land (or part thereof) would be leased from Ausgrid for the duration of construction.

The expansion of the Homebush Bay Drive civil site (C1) would allow for:

- Utilisation of existing car parking spaces for around 300 construction personnel light vehicles
- Reconfiguration of site office, amenities and workshop facilities
- Reorientation of sedimentation basin and relocation of mulch and topsoil stockpile.

The sedimentation basin and mulch and topsoil stockpile would remain within the original footprint of the Homebush Bay Drive civil site (C1). The existing transmission line easement, below the high voltage transmission lines, would be an exclusion zone, with the exception of internal roads and a footpath to enable movements across the easement.

The expansion of the construction footprint would allow for changes to the layout of the Homebush Bay Drive civil site (C1), as shown in **Figure 2.1**.

### 2.1.1 Traffic and transport specific aspects

Specific traffic and transport design changes are listed below:

- Light vehicles would access car parking facilities at the Homebush Bay Drive civil site (C1) either via a left-turn movement from Homebush Bay Drive southbound or from the M4 Motorway on-ramp eastbound. Egress would be via a left-turn movement at the same locations to travel eastbound
- The existing right-turn movement from Homebush Bay Drive northbound would only provide access to the site via the M4 Motorway on-ramp eastbound. This is to avoid road safety concerns associated with vehicles turning first right and then left in quick succession to enter the site from Homebush Bay Drive, potentially conflicting with traffic using the M4 on-ramp. Vehicles making this movement would be required to give-way to southbound vehicles entering the Homebush Bay Drive civil site (C1) or M4 Motorway eastbound on-ramp; and this is likely to result in some additional queueing back to Homebush Bay Drive
- Alternatively, northbound light vehicles on Homebush Bay Drive could travel past the Homebush Bay Drive on ramp intersection, execute a u-turn via the Homebush Bay Drive and Australia Avenue grade-separated interchange, and then travel back south on Homebush Bay Drive and turn left into the Homebush Bay Drive civil site (C1)
- Heavy vehicles would access the Homebush Bay Drive civil site (C1) via left in and left out movements to the M4 Motorway on-ramp eastbound as shown in **Figure 2.1**.

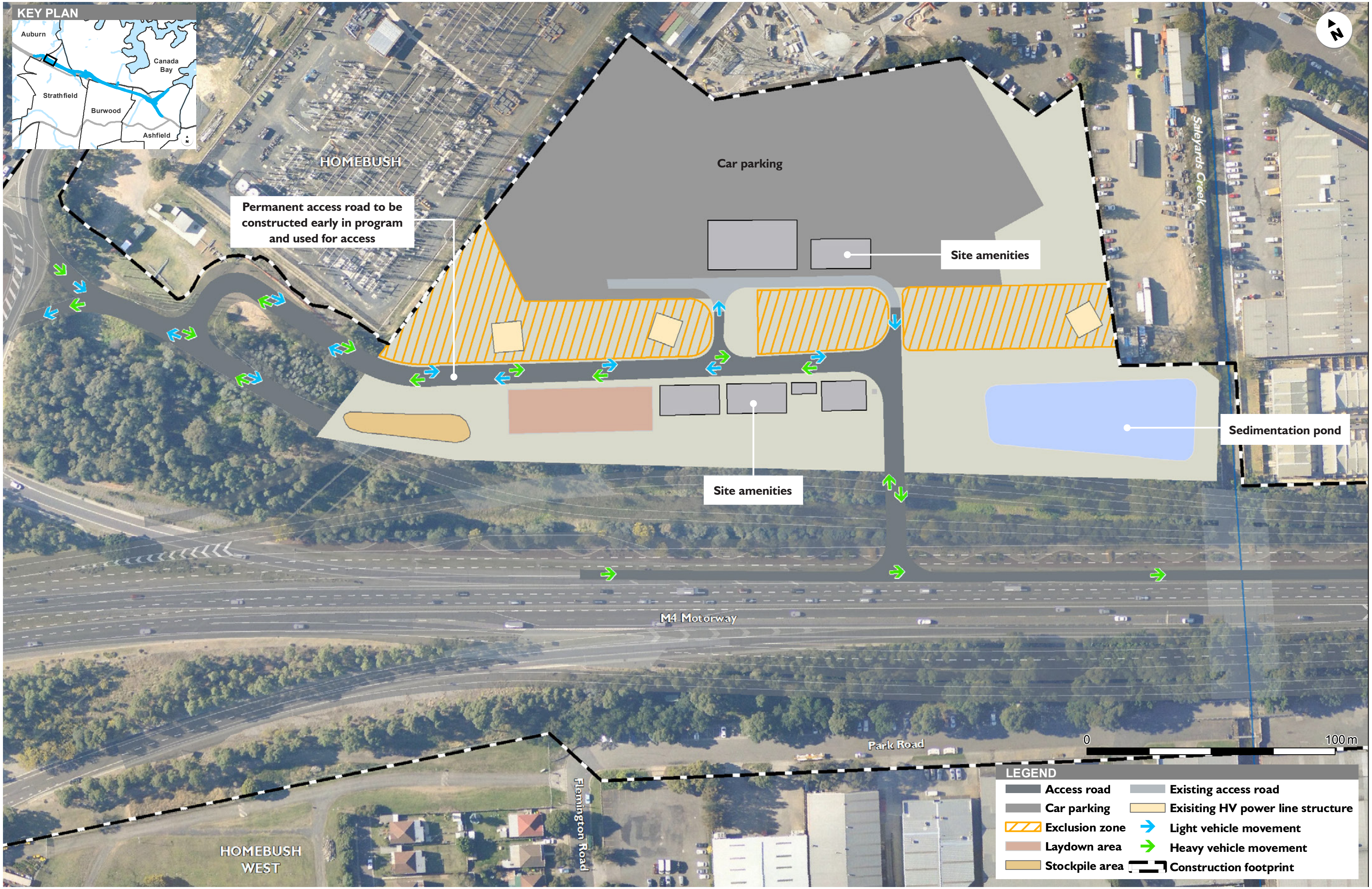


**Figure 2.1 Revised Homebush Bay Drive civil site (C1)**

## 2.2 Homebush Bay Drive interchange

In the M4 East EIS, the Homebush Bay Drive interchange included two major bridge structures near Saleyards Creek to carry surface M4 traffic over traffic entering and exiting the M4 East mainline tunnels. The layout of the traffic lanes could be considered as counter-intuitive, with traffic lanes to and from the new mainline tunnels provided on the outside of traffic lanes to and from the existing surface M4. To maintain eastbound access to the existing M4 from Homebush Bay Drive, the preferred design incorporates the construction of an elevated bridge up to eight metres in height adjacent to apartments on Verley Drive. The interchange as described in the EIS is depicted in **Figure 2.2** as an oblique elevation.

As a result of ongoing design development, the configuration of ramps and connections between the M4 and M4 East at the Homebush Bay Drive interchange is proposed to be modified. The purpose of these changes is to reduce the size of bridge structures, follow more direct grade lines and provide a more intuitive alignment for drivers entering and exiting at the Homebush Bay Drive interchange. The reconfiguration would also reduce potential visual and noise impacts on residents of Verley Drive.

The below sections outline the proposed changes to the configuration of this interchange. The new arrangement is shown in **Figure 2.3** as an oblique elevation and in **Figure 2.4** in plan view**.**

### M4 Motorway surface realignment

There would be no change to the western extent of the project and its connection to the M4 Widening project as described in section 5.5.1 of the EIS. Traffic lanes on the M4 would continue to be realigned so that the dominant traffic flow would be to and from the new mainline tunnels.

In the eastbound direction, a new lane for M4 surface traffic would be provided to the north of the existing traffic lanes, and would travel under a short bridge structure carrying the M4 East entry ramp from Homebush Bay Drive. This short bridge structure would replace the long bridge structure further to the east as described in the EIS. The M4 surface traffic lane would widen to two lanes as it joins with a lane from the Homebush Bay Drive on-ramp for M4 surface traffic.

In the westbound direction, two traffic lanes would be provided for M4 surface traffic, realigned to the south of the existing traffic lanes. These lanes would continue at grade (instead of on a large bridge structure, as described in the EIS) before merging with the existing M4 to the east of Homebush Bay Drive.

### Homebush Bay Drive eastbound on-ramp

As described in the EIS, the existing eastbound on-ramp from Homebush Bay Drive to the M4 would be realigned to the north.

At Homebush Bay Drive, the on-ramp would consist of one traffic lane which would provide access to the eastbound mainline tunnel. An added lane on the northern side would provide access to the surface M4 eastbound. Both lanes would include a small bridge structure over the proposed re-routed eastbound cycleway, which would travel through an underpass under the on-ramp (instead of on a bridge over the on-ramp, as described in the EIS).

Traffic from the Homebush Bay Drive on-ramp choosing to use the eastbound mainline tunnel would travel in the southern-most (inside) lane, over the cycleway underpass, then on the short bridge described above (over eastbound surface M4 traffic), and then merge with traffic travelling from the existing M4 east of Saleyards Creek. The design of the on-ramp widens to two lanes for managed motorway storage, before tapering back to one lane prior to merging with traffic travelling from the existing M4.

Traffic from the Homebush Bay Drive on-ramp choosing to use the surface M4 would travel in the northern-most (outside) lane, over the cycleway underpass. It would then join with the lane from the existing M4 described above, and would travel at grade before connecting to the existing M4 just west of Underwood Road.

### Homebush Bay Drive westbound off-ramp

The westbound off-ramp to Homebush Bay Drive would be realigned to the south and would diverge from the surface M4 just east of Derowie Avenue, which is further to the west than that described in the EIS.

Traffic coming out of the westbound mainline tunnel and choosing to exit at Homebush Bay Drive would use a new exit lane just west of Derowie Avenue, which would travel over Saleyards Creek and then over a second small bridge structure near Flemington Road, after which it would join the surface M4 to Homebush Bay Drive off-ramp. The two off-ramps would tie into the existing off-ramp about 250 metres east of the signalised intersection with Homebush Bay Drive.

### M4 East tunnel entrance and exit

There would be no changes to the M4 East tunnel entrance and exit and the surface M4 East section.

### Re-routed eastbound cycleway

The proposed re-routed cycleway would travel under the Homebush Bay Drive on-ramp via an underpass, rather than an overpass as described in the EIS. The off-road section of the re-routed eastbound cycleway has been shortened, and would connect back into the M4 shoulder on the eastbound Homebush Bay Drive on-ramp connection to the surface M4 about 150 metres east of the underpass. The cycleway underpass would be developed further during detailed design.

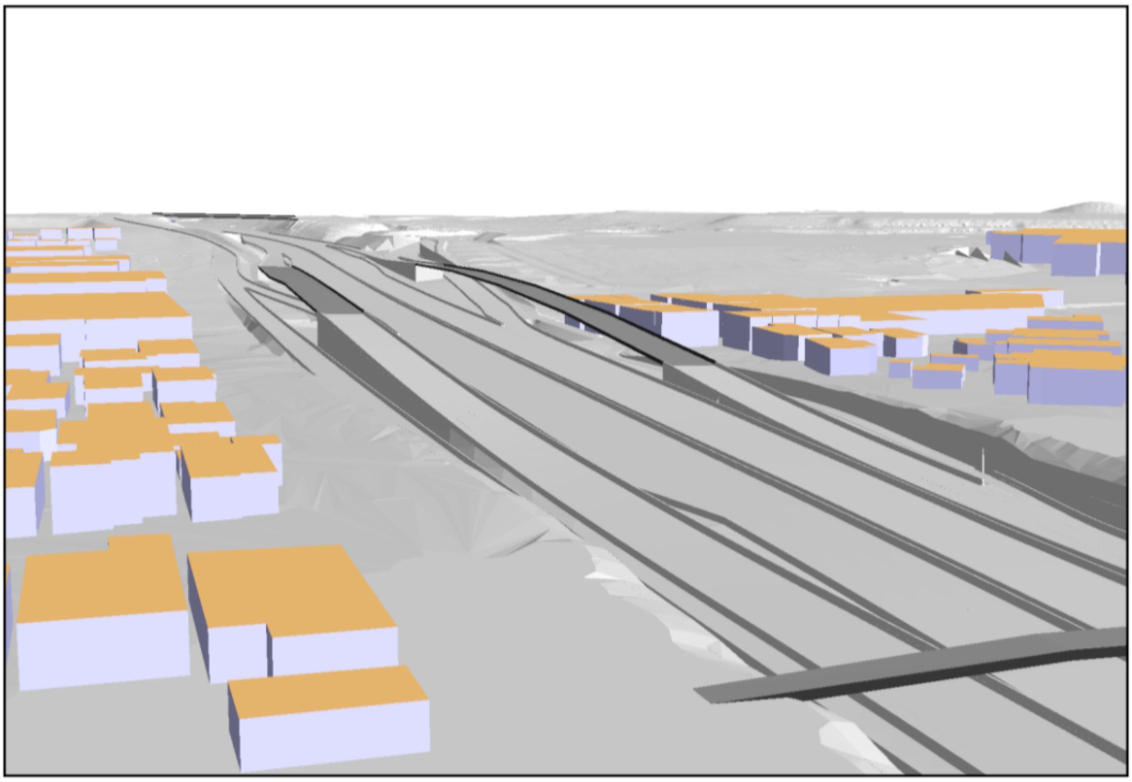

**Figure 2.2 EIS Homebush Bay Drive interchange (oblique elevation, facing west)**

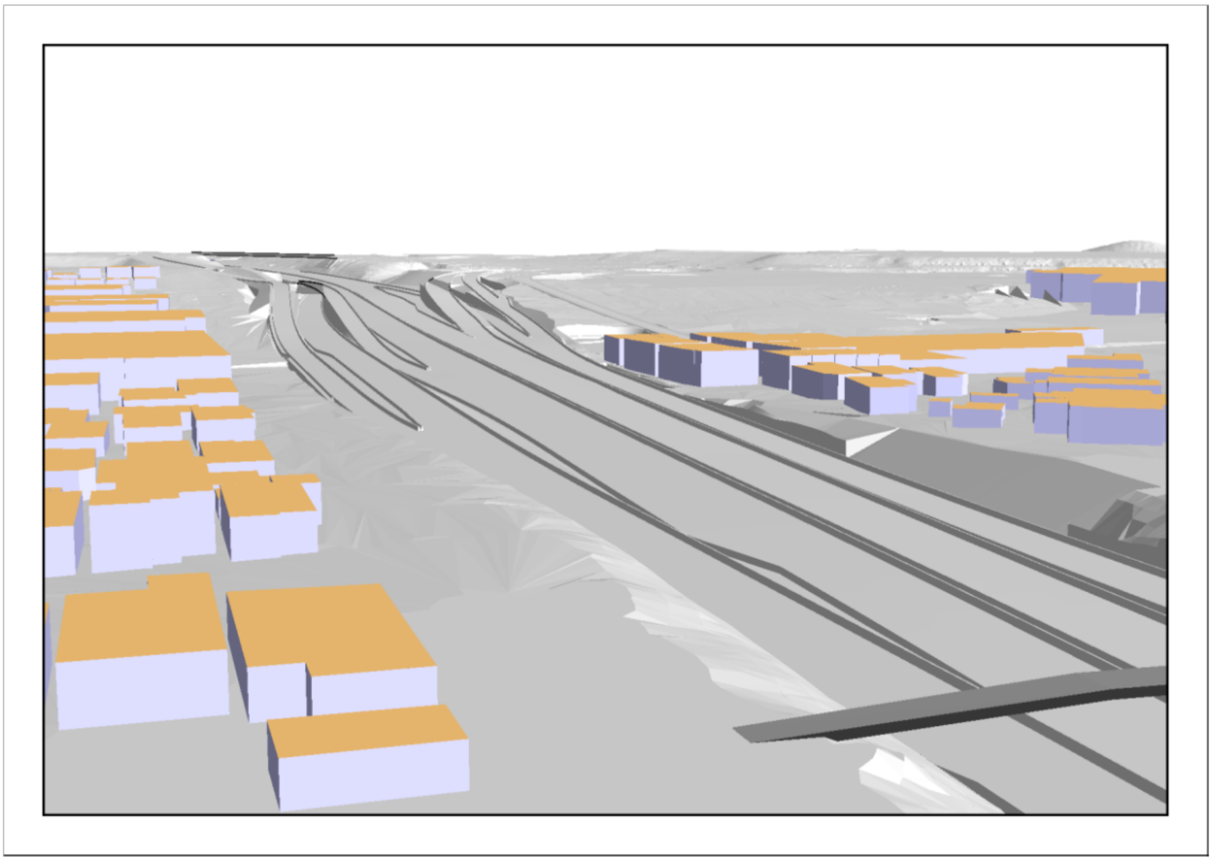

**Figure 2.3 Reconfigured Homebush Bay Drive interchange (oblique elevation, facing west)**


**Figure 2.4 Reconfigured Homebush Bay Drive interchange**

## 2.3 Wattle Street (City West Link) interchange

In the EIS, the Wattle Street (City West Link) interchange included separate cut and cover tunnel structures. The interchange as described in the EIS is depicted in **Figure 2.5** as an oblique elevation.

As a result of ongoing design development, the configuration of the Wattle Street interchange is proposed to be modified. The purpose of these changes is to combine the dive and cut and cover structures for both the M4 East ramps and the M4-M5 Link ramps.

The below sections outline the proposed changes to the configuration of the interchange. The new arrangement is shown in **Figure 2.6** as an oblique elevation and in plan view in **Figure 2.7**.

### M4 East tunnel exit to Wattle Street

The M4 East tunnel exit to Wattle Street would not be altered significantly. The tunnel portal would remain on the northern side of Ramsay Street.

The dedicated right turn bay at the Waratah Street signalised intersection would remain for traffic exiting the eastbound mainline tunnel only.

### M4 East tunnel entrance from Wattle Street

The M4 East tunnel entry from Wattle Street would be relocated further to the east, so that the on-ramp would be the eastern-most (kerbside) lane while the surface Wattle Street would continue in the centre lanes. The dive structure for this on-ramp would start on the southern side of Martin Street. The tunnel portal would remain on the northern side of Ramsay Street.

There would be no other change to the on-ramp.

### Wattle Street surface adjustments

The surface Wattle Street eastbound lanes would not change as part of the modification of the interchange.

The surface Wattle Street westbound lanes would be realigned to the east of its existing alignment; however, it would continue in the centre lanes (instead of the kerbside lanes as described in the EIS). To do this, the surface lanes would travel over the cut and cover sections of the M4–M5 Link on- and off-ramps.

South of Ramsay Street, the westbound surface Wattle Street lanes would still split as described in the EIS, two separate sets of lanes providing access to Parramatta Road westbound, and Parramatta Road eastbound or Frederick Street southbound.

North of Waratah Street, the surface works would remain on the same general alignment.

### M4–M5 Link on- and off-ramps tunnels

The M4-M5 Link cut and cover structures would start in approximately the same location as described in the EIS, but would be realigned so that they are positioned between the M4 East on- and off-ramps. The on- ramp dive structure would be lengthened, while the off-ramp dive structure would be shortened.

### Martin Street intersection works

A cul-de-sac would be established at Martin Street abutting the eastern side of the project.

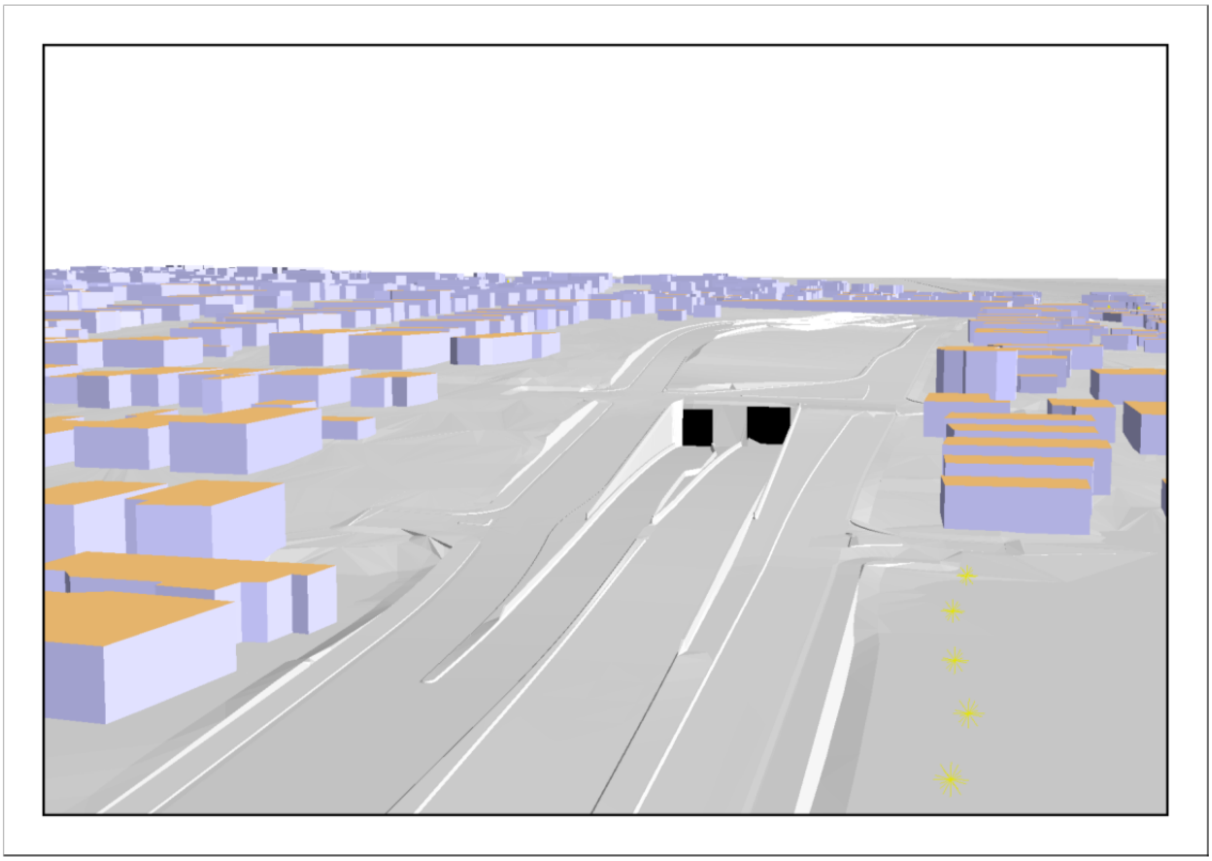

**Figure 2.5 EIS Wattle Street interchange (oblique elevation, facing south)**

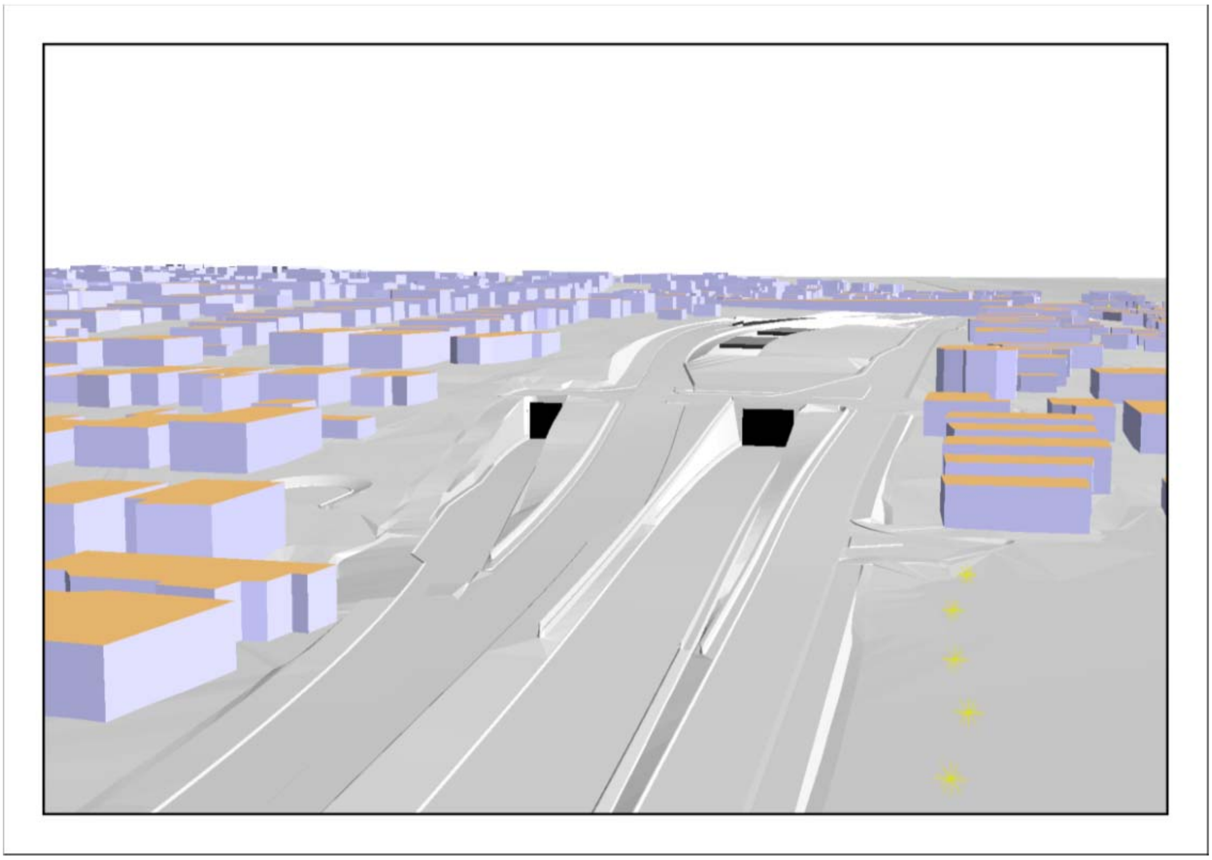

**Figure 2.6 Reconfigured Wattle Street interchange (oblique elevation, facing south)**


Figure 2.7 Reconfigured Wattle Street (City West Link) interchange

## 2.4 Ramsay Street and Martin Street (west) intersection works

The Wattle Street (City West Link) interchange as described in the EIS and as amended by the design change described in **section 2.3** would limit traffic movements into and out of Martin Street, on the western side of Wattle Street to left in and left out only. As the intersection of Martin Street and Ramsay Street is currently closed to traffic, vehicles leaving Martin Street and wishing to travel westbound on Wattle Street would need to turn left onto Wattle Street then travel about 700 metres to Timbrell Drive, and then perform a u-turn at the roundabout at the intersection on Timbrell Drive and Henley Marine Drive. Similarly, eastbound vehicles on Wattle Street wishing to enter Martin Street would need to turn right at Timbrell Drive, and then travel along a circuitous route via Henley Marine Drive, Ramsay Street, Wattle Street and then left into Martin Street. Both of these routes would add considerable travel time to residents and visitors to Martin Street (west).

In order to provide acceptable connections to Martin Street, it is proposed to undertake works at the currently closed intersection of Ramsay Street and Martin Street. This intersection would be reopened to traffic and all turning movements into and out of the western end of Martin Street would be permitted. Signal control is not proposed at this location due to the low turning volumes anticipated. The proximity of the upstream and downstream signals is anticipated to provide sufficient gaps for turning vehicles. Parking restrictions on Ramsay Street may require further investigation to ensure right turning vehicles do not impact through traffic on Ramsay Street.

In addition, to prevent rat-running by motorists seeking to avoid the Ramsay Street and Wattle Street intersection, the eastern end of Martin Street (west) would be altered to be left in only, with the left turn out movement prohibited. Geometric changes to the intersection would be required to physically restrict egress to Wattle Street. This would retain the low volume, residential nature of the existing street. **Figure 2.8** illustrates the proposed movements.


**Figure 2.8** **Proposed alterations to the Ramsay Street and Martin Street (west) intersection**

# 3 Clarifications

## 3.1 Temporary closure of Ramsay Street

Temporary closure of Ramsay Street (south of Wattle Street) may be required, as an alternative construction method to accommodate for the construction of the cut and cover section of the dive structure.

The contractor has identified the following three potential Ramsay Street closure options:

1. Ramsay Street full temporary closure seven days a week for around four months
2. Ramsay Street full temporary closure during a combination of weekends (Friday night to Monday morning), long weekends (i.e. Friday night to Tuesday morning) and school holiday (for the full two weeks of holiday period). The road would re-open Monday morning to Friday night. However, this option would still require the full temporary closure of Ramsay Street (option 1) during sporadic periods of major construction works
3. As per option two, but night-time closures only during Sunday to Thursday night (generally no Friday or Saturday nights) and re-opening of Ramsay Street each morning.

During the period of the Ramsay Street closure, the following diversions would be put in place:

- For traffic heading eastbound on Ramsay Street, a new right turn onto Wattle Street would be provided. Traffic would then turn left onto Parramatta Road and then left into Dalhousie Street
- For traffic heading westbound on Ramsay Street, traffic would turn left onto Dalhousie Street, right onto Parramatta Road, and then right onto Great North Road
- For traffic heading eastbound on Wattle Street, no detour is proposed as there is currently no right turn into Ramsay Street
- For traffic heading westbound on Wattle Street, traffic would turn left onto Waratah Street, right onto Alt Street and then left onto Ramsay Street.

## 3.2 Available lanes on Parramatta Road

During construction it is proposed that the available lane capacity on Parramatta Road between Bland Street and Dalhousie Street would be reduced from three lanes to two lanes. This would impact on both the eastbound and westbound carriageways as they pass the Parramatta Road civil site (C10).

The Traffic and Transport Assessment in Appendix G of the EIS assessed construction impacts on the roadway level of service along this section of Parramatta Road assuming that three traffic lanes would be available (refer section 7.4.2 and Table 7.15 of Appendix G of the EIS – Traffic & Transport Assessment).

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# 4 Existing environment

The existing traffic and transport environment that would be impacted by the design changes is the same as the original assessment. Section 5 of Appendix G: traffic and transport assessment provides further details of the existing traffic and transport environment and **Chapter 6** provides further details on the existing road network performance.

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# 5 Assessment of impacts

## 5.1 Homebush Bay Drive civil site (C1) expansion

### 5.1.1 Construction impacts

Traffic modelling for the construction impact assessment has been updated to determine the predicted performance of key signalised intersections; based on revised light vehicle traffic volumes travelling to/from the expanded Homebush Bay Drive civil site (C1).

The assessment has only been undertaken for cluster 3 as this includes modelled intersections that would be impacted and where significant volumes of construction traffic pass through the network; as shown in **Figure 5.1**. The construction traffic volumes as a proportion of total traffic at the cluster 1 intersections was so low as to not warrant modelling of impacts at these intersections.


**Figure 5.1 Modelled intersections (cluster 3)**

Intersection performance results under the 2017 travel demands forecast with the additional construction traffic are summarised in **Table 5-1** and **Table 5-2**; for the AM peak and PM peak respectively. As discussed in the EIS Traffic and Transport paper, 2017 has been chosen as the construction scenario based on peak workforce and activity projections. The tables show passenger car units (PCUs), average delay and level of service (LoS) for the following three scenarios:

- Without construction
- With construction (as assessed in the EIS)
- With construction (C1 design change).

The EIS provides details of comparative operational impacts between the without construction and with construction scenarios. Consequently, the objective of this assessment is to compare the two with construction scenarios (EIS and C1 design change) for cluster 3.

Key observations from **Table 5-1** and **Table 5-2** include:

- AM peak results for the 2017 with construction (C1 design change) scenario are very similar to figures reported in the EIS; with predicted operational performance ranging from LoS C to LoS F for the four modelled intersections
- PM peak results for the 2017 with construction (C1 design change) scenario are very similar to figures reported in the EIS; with predicted operational performance ranging from LoS D to LoS F for the four modelled intersections.

The provision of additional carparking (up to 300 spaces) on the Ausgrid land during the construction period is a significant improvement particularly at this western end of the project. The increased on site car parking provision reduces the potential for use of on street parking in local streets by the construction workforce.

**Table 5-1 2017 AM peak period intersection operational performance summary (cluster 3)**

| Intersection | Without construction | | | With construction (EIS) | | | With construction (EIS C1 design change) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) |
| Patterson Street \| Concord Road | 3312 | 84 | F | 3364 | 98 | F | 3364 | 97 | F |
| Sydney Street \| Concord Road | 2974 | 25 | B | 3061 | 29 | C | 3073 | 32 | C |
| Parramatta Road \| Concord Road | 4499 | 70 | E | 4682 | 80 | F | 4654 | 66 | E |
| Parramatta Road \| M4 | 6188 | 69 | E | 6657 | 94 | F | 6473 | 84 | F |

**Table 5-2 2017 PM peak period intersection operational performance summary (cluster 3)**

| Intersection | Without construction | | | With construction (EIS) | | | With construction (EIS C1 design change) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) |
| Patterson Street \| Concord Road | 3530 | 42 | D | 3591 | 43 | D | 3591 | 43 | D |
| Sydney Street \| Concord Road | 3386 | 38 | C | 3448 | 76 | F | 3444 | 72 | F |
| Parramatta Road \| Concord Road | 4841 | 133 | F | 5059 | 137 | F | 4989 | 141 | F |
| Parramatta Road \| M4 | 5806 | 48 | D | 6227 | 52 | D | 6032 | 50 | D |

### 5.1.2 Operational impacts

Key operational traffic and transport impacts are noted as follows:

- The eastbound on-ramp layout has changed at the Homebush Bay Drive interchange. Vehicles accessing the surface M4 from Homebush Bay Drive would now stay left for eventual egress from the motorway at Concord while those continuing to the M4 East would veer right. This forms a more intuitive and safer arrangement than the design assessed at EIS stage where the positions were reversed
- The westbound off-ramp layout has changed at Homebush Bay Drive. Vehicles exiting the surface M4 to Homebush Bay Drive would now stay left rather than veering right
- There is no change to lane configurations approaching the signalised M4 intersections at Homebush Bay Drive, Parramatta Road or Concord Road which were assessed in the EIS
- There is no change to bus movements accessing the eastbound on ramp from Sydney Olympic Park which were assessed in the EIS
- Cyclist connection between Sydney Olympic Park and the eastbound M4 shoulder has been amended to occur via an underpass of the eastbound on-ramp rather than the overbridge assessed in the EIS. The distance of this cycle route remains similar.

The changes proposed would provide more intuitive movements by motorists moving between the Homebush Bay Drive ramps and the surface M4 Motorway, and represents a better outcome from a road safety perspective. The traffic modelling assessments contained within the EIS are not affected as the immediate approach lanes to the relevant intersections are unchanged.

The ultimate design of the cyclist underpass should be well lit and attractively designed to provide a safe environment for cyclists and to avoid the possibility of unsocial behaviour.

## 5.2 Wattle Street (City West Link) interchange

### 5.2.1 Operational impacts

Key operational traffic and transport impacts are noted as follows:

- Closure of Martin Street (east):
  - The latest M4 East design changes incorporate a restriction on traffic movements between Wattle Street and Martin Street (east of Wattle Street). A cul-de-sac would be established in Martin Street on the eastern side of its junction with Wattle Street. This represents a change from the design assessed in the EIS. A full movement restriction represents a continuation of the temporary construction situation, for a duration of 25 months, as assessed within the EIS. Reduction of conflicts between turning movements and traffic flows on Wattle Street would provide a small benefit in terms of road safety
  - The existing situation at this intersection only accommodates left turn movements from Martin Street to Wattle Street, with a temporary barrier erected by Ashfield Council to physically discourage left turns from Wattle Street. During the consultation process, Ashfield Council indicated their opposition to accommodating any additional turning movements. A site survey undertaken on the 20 and 21 October 2015 identified only three left turn movements in the AM peak hour, and five movements in the PM peak hour. Restriction of this movement therefore impacts a limited number of existing movements. Furthermore, an obvious and convenient alternative route is available via Alt Street and then either Ramsay Street or Waratah Street. No significant traffic and transport impacts are therefore forecast.
- Realignment of westbound carriageways for Wattle Street and M4 East Motorway on-ramp:
  - The realignment has no impact on lane arrangements or capacity at any of the signalised intersections assessed in the EIS. The revised arrangement which requires M4 Motorway on-ramp traffic to slip left rather than veer right is more intuitive and results in a reduction in the overall width of the combined Wattle Street and M4 East carriageways. The proposed arrangement may however result in a slight additional risk of conflict between westbound cyclists on Wattle Street and vehicles accessing the M4 East.

- Reduction of distance between Ramsay Street intersections with Wattle Street:
  - The realignment of the westbound carriageway of Wattle Street results in a small reduction in the distance between the eastbound and westbound carriageways of Wattle Street at the Ramsay Street intersection by comparison with the EIS design. This reduces the long phase intergreen assumed at EIS stage between Ramsay Street movements and Wattle Street movements (due to the length of time required for Ramsay Street traffic to safely clear both carriageways). As a result, there would be a small increase in traffic capacity at the intersection due to a reduction in all red time.

## 5.3 Ramsay Street and Martin Street (west) intersection works

### 5.3.1 Operational impacts

This design change provides significant benefits for residents in comparison to the scenario assessed for the EIS. The key benefits and constraints for residents impacted by the intersection works are:

- Establishment of a Martin Street, Ramsay Street and Wolseley Street intersection. Currently there is no connectivity between Martin Street and these two streets. As part of this design change it is proposed that all movements would be permitted at this location. Signal control is not proposed due to the predicted low volume of turning vehicles
- The proximity of the upstream and downstream traffic signals on Ramsay Street is anticipated to provide sufficient gaps for turning vehicles. Parking restrictions on Ramsay Street may require further investigation to ensure right turning vehicles do not impact through traffic travelling on Ramsay Street
- No access from Martin Street onto Wattle Street. The removal of this movement is a key requirement to ensure that Martin Street is not utilised as a rat run by motorists seeking to avoid the Ramsay Street and Wattle Street signals. This retains the residential nature of the existing street
- Geometric changes may be required to physically restrict egress from Martin Street into Wattle Street. Currently, a number of illegal movements turn into the one-way Martin Street access at this location during peak hours
- The combination of these movements mean that the affected residents would be afforded access to and egress from their properties in all directions without necessitating lengthy detours and time delays.

Due to the small number of trips anticipated to utilise Martin Street on completion of the intersection works, it is expected that operational impacts on the surrounding network would be minimal. A slight increase in vehicles at the Ramsay Street and Wattle Street intersection is likely to be most significant outcome; however this increase would be minor when considering overall traffic volumes at this location.

## 5.4 Temporary closure of Ramsay Street

### 5.4.1 Construction impacts

A construction scenario requiring the temporary closure of Ramsay Street, south of Wattle Street, has been proposed to accommodate construction of the cut and cover section of the dive structure. Three potential closure options have been identified by the contractor as outlined in **section 2.5**. For the purposes of this assessment a full temporary closure seven days a week over a period of up to four months has been assumed as the most conservative traffic scenario.

Traffic modelling for the construction impact assessment has been updated to determine the predicted performance of key signalised intersections during this specific period. The impacts have been assessed as an alternative construction scenario, and the assessment has only been undertaken for cluster 6 where the local redistribution of traffic would be concentrated; as shown in **Figure 5.2**.

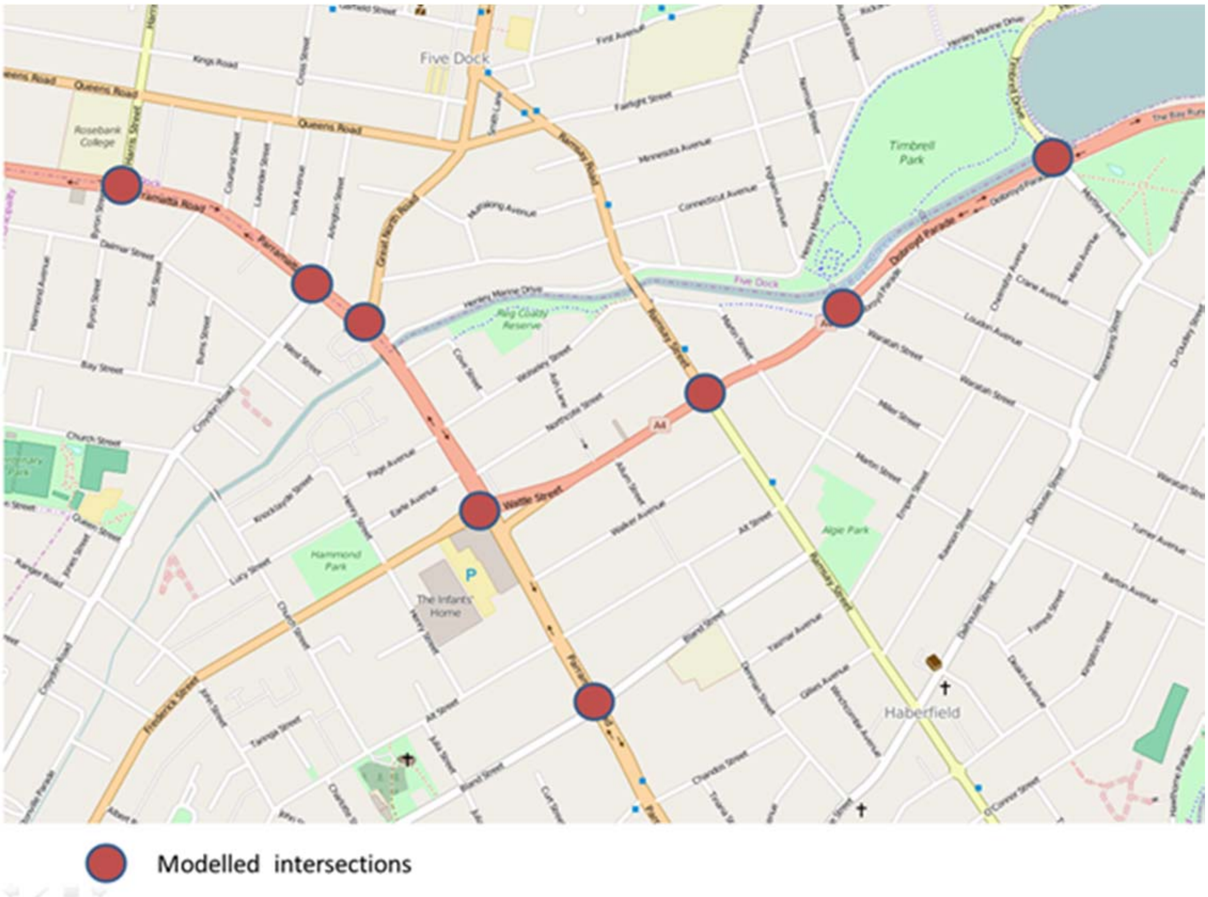


**Figure 5.2** **Modelled intersections (cluster 6)**

The 2021 'do minimum' volumes were assessed with and without the Ramsay Street closure to identify the forecast redistribution of volumes from Ramsay Street. These differences in volumes were then applied to the 2017 with construction scenario. This was a robust methodology as traffic growth between 2017 and 2021 was included and a slightly higher level of traffic was therefore assessed.

The results are summarised in **Table 5-3** and **Table 5-4.**

The closure of Ramsay Street resulted in the following changes:

- The through lane on Ramsay Street eastbound was assumed to be allocated to a new right turn movement to Wattle Street, to accommodate diverting traffic during the period of the closure
- Increases in traffic as a result of the closure are evident on Timbrell Drive, Mortley Avenue, Waratah Avenue, Great North Road and Bland Street. There is a particularly large increase in the right turn from Parramatta Road to Great North Road
- Decreases in traffic occur on Ramsay Street (north of Wattle Street), Great North Road southbound (PM peak) and on the right turn from Wattle Street to Parramatta Road.

Intersection performance results are summarised in **Table 5-3** and **Table 5-4**; for the AM peak and PM peak respectively. The tables show PCUs, average delay and LoS for the following three scenarios:

- Without construction
- With construction (as assessed in the EIS)
- With construction and Ramsay Street closure (potential design change).

**Table 5-3 2017 AM peak period intersection operational performance summary (cluster 6)**

| Intersection | Without construction | | | With construction (EIS) | | | With construction (Ramsay Street temporary closure) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) |
| Bland Street \| Parramatta Road | 4252 | 11 | A | 4380 | 12 | A | 4923 | 31 | C |
| Frederick Street \| Parramatta Road | 7217 | 71 | F | 7536 | 89 | F | 8002 | 79 | F |
| Great North Road \| Parramatta Road | 5928 | 51 | D | 6293 | 56 | D | 6469 | 126 | F |
| Arlington Street \| Parramatta Road | 5724 | 62 | E | 6089 | 87 | F | 6091 | 95 | F |
| Harris Road \| Parramatta Road | 4962 | 38 | C | 5327 | 37 | C | 5342 | 38 | C |
| Ramsay Street \| Wattle Street | 4702 | 120 | F | 4920 | 125 | F | 4022 | 39 | C |
| Dobroyd Parade \| Waratah Avenue | 3544 | 19 | B | 3632 | 37 | C | 3686 | 42 | C |
| Dobroyd Parade \| Timbrell Drive | 4926 | 55 | D | 4926 | 48 | D | 5028 | 69 | E |

**Table 5-4 2017 PM peak period intersection operational performance summary (cluster 6)**

| Intersection | Without construction | | | With construction (EIS) | | | With construction (Ramsay Street temporary closure) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) | Passenger car unit (PCU) | Average delay (seconds) | Level of service (LoS) |
| Bland Street \| Parramatta Road | 4066 | 12 | A | 4231 | 11 | A | 4622 | 22 | B |
| Frederick Street \| Parramatta Road | 7428 | 78 | F | 7734 | 117 | F | 7977 | 74 | F |
| Great North Road \| Parramatta Road | 6118 | 50 | D | 6470 | 50 | D | 6470 | 82 | F |
| Arlington Street \| Parramatta Road | 6082 | 65 | E | 6434 | 80 | F | 6419 | 84 | F |
| Harris Road \| Parramatta Road | 5532 | 30 | C | 5884 | 27 | B | 5879 | 28 | B |
| Ramsay Street \| Wattle Street | 4283 | 37 | C | 4432 | 38 | C | 3978 | 40 | C |
| Dobroyd Parade \| Waratah Avenue | 3633 | 27 | B | 3700 | 58 | E | 3764 | 97 | F |
| Dobroyd Parade \| Timbrell Drive | 5011 | 38 | C | 5011 | 38 | C | 5129 | 55 | D |

The EIS provides details of comparative operational impacts between the without construction and with construction scenarios. Consequently, the objective of this assessment is to compare the two with construction scenarios for cluster 6. Key observations from the assessment as shown in **Table 5-3** and **Table 5-4** include:

- AM peak results for the 2017 with construction (Ramsay Street closure) scenario show a number of changes from the main construction scenario reported in the EIS; with greatly reduced delay at the Ramsay Street and Wattle Street intersection and some improvement at the Parramatta Road and Wattle Street intersection due largely to a reduction in right turners
- AM peak results also show that there is a large increase in delay at the Parramatta Road - Great North Road intersection which moves to LoS F. Other intersections experiencing increased delay include Timbrell Drive and Dobroyd Parade (moving to LoS E), and minor increases in delay at Parramatta Road intersections with Harris Road, Arlington Street and Bland Street
- PM peak results for the 2017 with construction (Ramsay Street closure) scenario show a number of similar changes as the AM peak with a large increase in average delay at Great North Road, and smaller increases at Harris Road, Arlington Street and Timbrell Drive intersections. Of particular note is the large increase in delay at the Waratah Street intersection, primarily caused by an increase in right turners from the shared northbound through lane on Wattle Street
- There is a large reduction in delay at the Parramatta Road and Wattle Street intersection due to a combination of upstream congestion at Great North Road and a reduction in right turners. There is however limited impact in average delay at the Ramsay Street and Wattle Street intersection as there had been little modelled congestion during the main construction scenario.

In addition the temporary closure of Ramsay Street during construction is predicted to result in a number of operational impacts to other intersections in the Haberfield area, particularly the Parramatta Road/Great North Road intersection and Waratah Avenue/Dobroyd Parade intersection (PM peak).

Further traffic assessment would be undertaken to determine the most efficient and least disruptive option for the temporary closure of Ramsay Street in consultation with Roads and Maritime, Traffic Management Centre and SMC.

## 5.5 Available traffic lanes on Parramatta Road

### 5.5.1 Construction impacts

**Table 5-5** and **5-6** show the level of service (LoS) for a mid-block location on Parramatta Road between Bland Street and Dalhousie Street; based on a comparison of the availability of three lanes (as assessed in the EIS) and two lanes (as revised) in each direction during the construction period

**Table 5-5 Construction year (2017) mid-block operational performance summary (EIS)**

| Location and direction | | No. lanes | AM peak hour (veh/hr) | | | PM peak hour (veh/hr) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Flow | V/C | LOS | Flow | V/C | LOS |
| Parramatta Road between Bland Street and Dalhousie Street – Haberfield | EB | 3 | 2099 | 0.78 | D | 2185 | 0.81 | D |
| | WB | 3 | 1840 | 0.68 | D | 1668 | 0.62 | D |

**Table 5-6 Construction year (2017) mid-block operational performance summary (REVISED)**

| Location and direction | | No. lanes | AM peak hour (veh/hr) | | | PM peak hour (veh/hr) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Flow | V/C | LOS | Flow | V/C | LOS |
| Parramatta Road between Bland Street and Dalhousie Street – Haberfield | EB | 2 | 2099 | 1.17 | F | 2185 | 1.21 | F |
| | WB | 2 | 1840 | 1.02 | F | 1668 | 0.93 | E |

The temporary lane reduction would reduce capacity, and the operational performance of vehicles travelling on this section of Parramatta Road is predicted to deteriorate from LoS D to LoS E and F. This demonstrates that the theoretical roadway capacity would be exceeded.

On major arterial routes with closely spaced signalised intersections, mid-block capacities and level of service are often a secondary performance measure as the key constraint is the performance of the signalised intersections. There are numerous arterial roads in Sydney, including other sections of Parramatta Road, which would operate at similar levels of performance.

As such, it is recommended that:

- a review of the operation of signalised intersections on the approach to and departure from the Parramatta Road lane closures would be undertaken to ensure that this section of the network continues to operate at maximum efficiency
- in consultation with TMC, an assessment would be undertaken to determine the optimum extent of the proposed lane closure and also the timing of these works in relation to other temporary road closures proposed during construction.

# 6 Additional management measures

**Table 6-1** provides details of additional environmental management measures that have been identified from an assessment of the traffic and transport impacts associated with the proposed design changes. It should be noted that relevant construction and operational management measures that are listed in section 8.6 of the EIS are also applicable to design changes referenced in this report.

**Table 6-1 Additional environmental management measures**

| Impact | Environmental management measure | Responsibility | Timing |
|---|---|---|---|
| **Construction** | | | |
| Temporary closure of Ramsay Street | A traffic management and safety plan (TSMP) would be prepared in addition to the construction environmental management plan (CEMP). The TSMP would include the guidelines, general requirements and principles of traffic management to be implemented during the proposed Ramsay Street closure. | Construction contractor | Pre-construction |
| Temporary closure of Ramsay Street | In addition to the development of a TSMP, the following mitigation strategies would be implemented to manage and control traffic operation and access during the closure period:<br>• The contractor would further review and develop the three proposed Ramsay Street closure options to establish an optimum construction strategy that would aim to have the minimum amount of disruption to affected residents<br>• Manage and maintain adequate property access by providing reasonable and practical alternate traffic routes which would be effectively communicated to the community. This would be undertaken in consultation with Roads and Maritime, local councils and property owners likely to be affected. | Construction contractor | Pre-construction |

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# 7 Conclusion

This report has assessed the traffic and transport impacts associated with the proposed design changes being considered as part of the Preferred Infrastructure Report. The key findings of this assessment are summarised below:

### Homebush Bay Drive civil site (C1)

The proposed expansion of the Homebush Bay Drive civil site (C1) would have no material impact on overall construction traffic volumes and would have similar impacts on the performance of surrounding intersections to those reported in the EIS.

The provision of an additional carparking for the construction workforce would be beneficial and would reduce reliance on on-street parking in surrounding streets.

### Homebush Bay Drive interchange

The changes in the configuration of the Homebush Bay Drive interchange would provide more intuitive movements by motorists moving between the Homebush Bay Drive ramps and the M4 which is a better outcome from a road safety perspective

The results of the operational traffic modelling assessment in the EIS remain unchanged and there are no changes to the immediate approach lanes to intersections. There are also no material changes to bus and cyclist movements which were assessed in the EIS

### Wattle Street interchange

The proposed design change for the Wattle Street interchange would result in:

- The closure of Martin Street east of its junction with Wattle Street which would remove the existing left out movement only. This restriction would only affect a limited number of movements and convenient alternative routes are available
- The re-alignment of carriageways for Wattle Street and the M4 East on-ramp and the revised arrangement is a better outcome from a road safety perspective
- Reduction in the distance between the eastbound and westbound carriageways of Wattle Street at the Ramsay Street intersection would result in a small increase in traffic capacity at this intersection due to a reduction in all red time

### Ramsay Street and Martin Street (west) intersection works

The proposed intersection works at Ramsay Street and Martin Street (west) would provide improved access in all directions to properties in this section of Martin Street by comparison to the scenario assessed in the EIS which would have involved lengthy and time consuming detours.

Geometric changes may be required to physically restrict egress from Martin Street (west) to Wattle Street to prevent potential rat running.

Operational impacts on the surrounding road network associated with this proposed design change are expected to be minimal.

### Temporary Closure of Ramsay Street

The temporary closure of Ramsay Street south of Wattle Street during construction would require traffic to divert to alternative routes. The assessment indicates that there is likely to be:

- Increases in traffic on a number of roads and decreases in traffic on a smaller number of roads
- Increases in delay at a number of intersections and decreases in delay at a smaller number of intersections

Additional management measures are proposed to mitigate potential impacts during the closure period.

**Available traffic lanes on Parramatta Road**

During construction it is proposed that the available lane capacity on Parramatta Road between Bland Street and Dalhousie Street would be reduced from three lanes (as assessed in the EIS) to two lanes. This change would impact on both the eastbound and westbound carriageways as they pass the Parramatta Road civil site (c10).

The temporary lane reduction would reduce capacity and, as a result, the operational performance of vehicles travelling on this section of Parramatta Road is predicted to deteriorate from LoS D to LoS E and F. This would be similar to other sections of Parramatta Road near Strathfield, which are also expected to operate at LoS E and F levels during the construction phase of the project.

# Appendix D

## Noise and vibration assessment of design changes

WestConnex

# Roads and Maritime Services

WestConnex M4 East

Noise and vibration assessment of design changes

December 2015

**Prepared for**

Roads and Maritime Services

**Prepared by**

*SLR Consulting Australia Pty Ltd*

# Document controls

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| **Approval and authorisation** | |
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| Authorised by, AECOM Australia Pty Limited: | Jay Stricker<br>Industry Director - Transport |
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# Contents

# WESTCONNEX M4 EAST
# OPERATIONAL ROAD TRAFFIC NOISE IMPACT ASSESSMENT
# DESIGN CHANGE - HOMEBUSH BAY DRIVE INTERCHANGE

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# 1 Introduction

## 1.1 Background

Noise and vibration impacts during operation of the M4 East project have been assessed and reported in the noise and vibration technical paper (SLR report reference 610.13569-R2 dated 4 September 2015), included as part of the project's Environmental Impact Statement (EIS).

Since completion of the EIS, an alternative interchange arrangement at Homebush bay Drive has been proposed.

The change in alignment requires additional assessment as it is likely to change the predicted noise impacts at the surrounding noise-sensitive receivers when compared to the EIS assessment.

## 1.2 Scope of this report

SLR has been engaged by Sydney Motorway Corporation (SMC) to assess potential noise impacts due to the proposed new alignment at Homebush Bay Drive.

This report forms an addendum to the EIS noise and vibration technical paper and presents a summary of the operational road traffic noise impacts proposed new alignment at Homebush Bay Drive.

This report presents the results from the re-assessment of the proposed revised alignment. As such, it should be read in conjunction with the EIS noise and vibration technical paper which contains detailed descriptions and explanations on the assessment guidelines and methodologies used.

## 1.3 Guidelines

Consistent with the EIS noise and vibration technical paper, the following guidelines have been used for this assessment:

- Noise from the operation of the proposal is assessed in accordance with guidelines provided in the NSW Road Noise Policy (RNP) ((NSW) Environment Protection Agency (EPA), 2011) as interpreted by Roads and Maritime in the Noise Criteria Guideline (NCG) (Roads and Maritime, 2014).
- Guidance for additional noise mitigation is taken from the Noise Mitigation Guideline (NMG) (Roads and Maritime, 2014).
- Guidance for assessing the potential for sleep disturbance from maximum noise events is taken from Practice Note iii in the Environmental Noise Management Manual (ENMM) (Roads and Maritime, 2001).

## 1.4 Terminology

The assessment has used specific acoustic terminology throughout. An explanation of common terms is included as **Appendix A** for reference.

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# 2 Design Change - Homebush Bay Drive Interchange

## 2.1 Description of change

In the EIS, the Homebush Bay Drive interchange included two major bridge structures near Saleyards Creek to carry surface M4 traffic over traffic entering and exiting the M4 East mainline tunnels. The layout of the traffic lanes could be considered counter-intuitive, with traffic lanes to and from the new mainline tunnels provided on the outside of traffic lanes to and from the surface M4. This arrangement had the potential for the layout of the on- and off-ramps to be confusing for motorists.

Eastbound motorists wanting to enter the tunnel would have needed to use the northern (kerbside) lane, whereas drivers wanting to access the existing M4 (to the north of the tunnel) would have needed to use the southern lane. Westbound motorists wanting to continue on the M4 would have needed to go up and over a bridge and then back down onto the motorway rather than driving straight through at-grade. The proposed change would resolve these issues.

To maintain eastbound access to the existing M4 from Homebush Bay Drive, the design described in the EIS incorporated the construction of an elevated bridge up to eight metres in height adjacent to apartments on Verley Drive.

As a result of ongoing design development, the configuration of ramps and connections between the M4 and M4 East at the Homebush Bay Drive interchange is proposed to be modified. The purpose of these changes is to reduce the size of bridge structures, follow more direct grade lines and provide a more intuitive alignment for drivers entering and exiting at the Homebush Bay Drive interchange. The reconfiguration would also reduce potential visual and noise impacts on residents of Verley Drive.

The below sections outline the proposed changes to the configuration of this interchange. The new arrangement is shown in **Figure 2.1**.

## 2.2 M4 Motorway surface realignment

There would be no change to the western connection to the M4 Widening project as described in section 5.5.1 of the EIS. Traffic lanes on the M4 would continue to be realigned so that the dominant traffic flow would be to and from the new mainline tunnels.

In the eastbound direction, the lane for M4 surface traffic would be realigned to the north of the existing traffic lanes, and would travel under a short bridge structure carrying the M4 East entry ramp from Homebush Bay Drive. This short bridge structure would replace the long bridge structure further to the east as described in the EIS. The M4 surface traffic lane would widen to two lanes as it joins with a lane from the Homebush Bay Drive on-ramp for M4 surface traffic.

In the westbound direction, the two traffic lanes for M4 surface traffic would be realigned to the south of the existing traffic lanes. These lanes would continue at grade (instead of on a large bridge structure, as described in the EIS) before merging with the existing M4 to the east of Homebush Bay Drive.

## 2.3 Homebush Bay Drive eastbound on-ramp

As described in the EIS, the existing eastbound on-ramp from Homebush Bay Drive to the M4 would be realigned to the north.

At Homebush Bay Drive, the on-ramp would consist of one traffic lane which would provide access to the eastbound mainline tunnel. A lane on the northern side would provide access to the surface M4 eastbound. Both lanes would include a small bridge structure over the proposed re-routed eastbound cycleway, which would travel through an underpass under the on-ramp (instead of on a bridge over the on-ramp, as described in the EIS).


**Figure 2.1 Reconfigured Homebush Bay Drive interchange**

Traffic from the Homebush Bay Drive on-ramp choosing to use the eastbound mainline tunnel would travel in the southern-most (inside) lane, over the cycleway underpass, then on the short bridge described above (over eastbound surface M4 traffic) to merge with traffic travelling from the existing M4 east of Saleyards Creek. The design of the on-ramp widens to two lanes for managed motorway storage, before tapering back to one lane prior to merging with traffic travelling from the existing M4.

Traffic from the Homebush Bay Drive on-ramp choosing to use the surface M4 would travel in the northern-most (outside) lane, over the cycleway underpass. It would then join with the lane from the existing M4 described above, and would travel at grade before connecting to the existing M4 just west of Underwood Road.

## 2.4 Homebush Bay Drive westbound off-ramp

The westbound off-ramp to Homebush Bay Drive would be realigned to the south and would diverge from the surface M4 just east of Derowie Avenue, which is further to the west than the EIS configuration.

Traffic coming out of the westbound mainline tunnel and choosing to exit at Homebush Bay Drive would use a new exit lane just west of Derowie Avenue, which would travel over Saleyards Creek and a second small bridge structure near Flemington Road, after which it would join the surface M4 to Homebush Bay Drive off-ramp. The two off-ramps would tie into the existing off-ramp about 250 metres east of the signalised intersection with Homebush Bay Drive.

## 2.5 M4 East tunnel entrance and exit

There would be no changes to the M4 East tunnel entrance and exit portals and the M4 East surface configuration leading to the portals.

## 2.6 Re-routed eastbound cycleway

The proposed re-routed cycleway would travel under the Homebush Bay Drive on-ramp via an underpass, rather than an overpass as described in the EIS. The off-road section of the re-routed eastbound cycleway has been shortened, and would connect back into the M4 shoulder on the eastbound Homebush Bay Drive on-ramp connection to the surface M4 about 150 metres east of the underpass. The cycleway underpass would be developed further during detailed design.

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# 3 Operational noise goals and noise mitigation guidance

This assessment is undertaken with guidance from the NCG. The NCG documents Roads and Maritime's interpretation of the RNP. This is consistent with the approach taken in the EIS noise and vibration technical paper.

## 3.1 Guidance for consideration of reasonable additional noise mitigation

The NMG provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the adoption of road design and traffic management measures). These are:

**Trigger 1**

- The predicted Build noise level exceeds the NCG controlling criterion and the noise level increase due to the project (ie the noise predictions for the Build minus the No-Build) is greater than 2 dBA

**Trigger 2**

- The predicted Build noise level is 5 dBA or more above the criteria (exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the project

**Trigger 3**

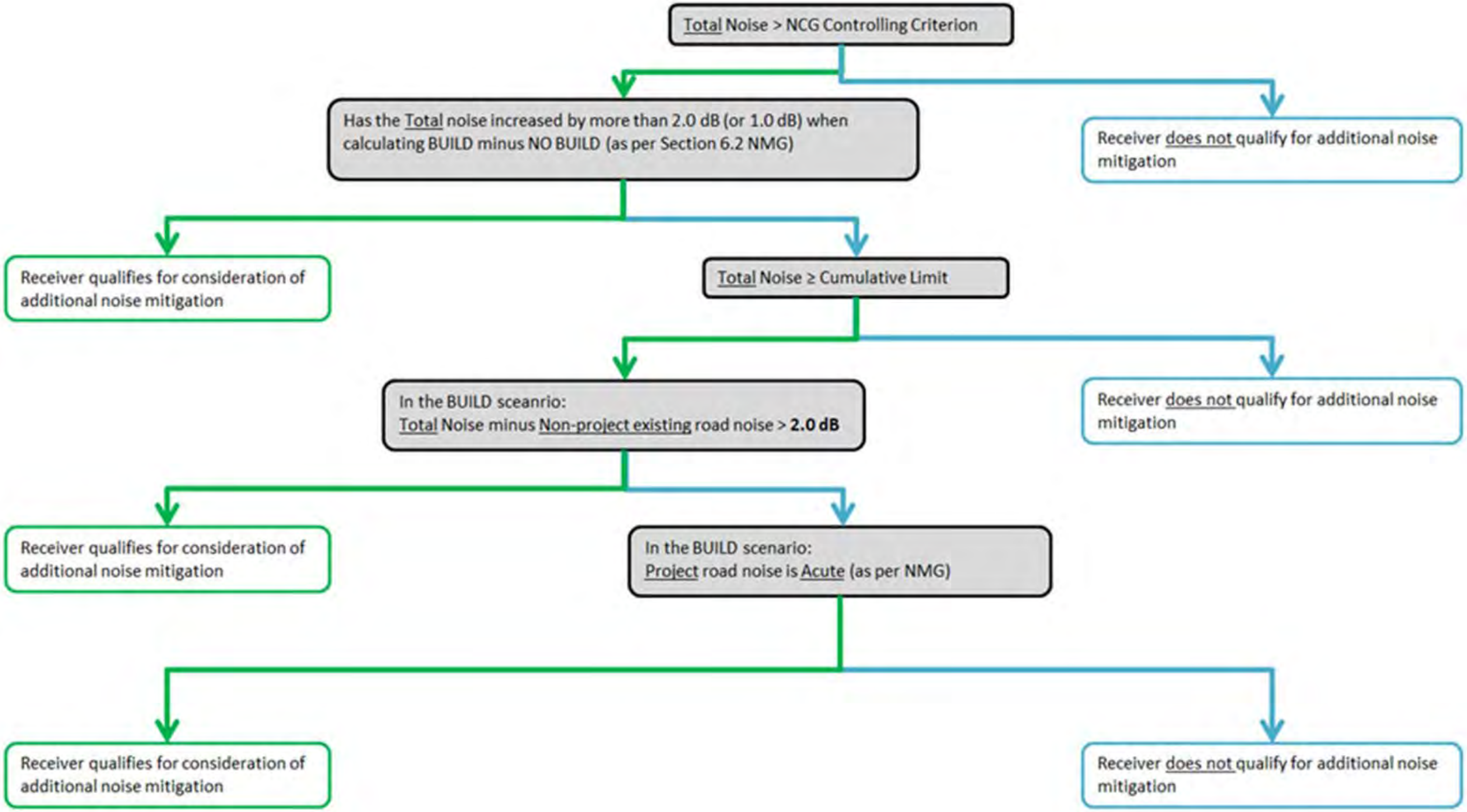
- The noise level contribution from the road project is acute (daytime LAeq (15hour) 65 dBA or higher, or night-time LAeq (9hour) 60 dBA or higher) then it qualifies for consideration of noise mitigation even if noise levels are dominated by another road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the benefit of additional noise mitigation (low noise pavement and noise barriers) is included. The requirement for the project is to provide feasible and reasonable additional mitigation for these eligible receivers to meet the NCG controlling criterion. If the NCG criterion cannot be satisfied with low noise pavement and noise barriers, then the receiver is eligible for consideration of at-property treatment.

Further detail on the process of applying the NMG is presented in the EIS noise and vibration technical paper.

The NMG process is summarised in the flowchart in **Figure 3.1**.

**Figure 3.1 Flowchart - Reasonable and feasible noise mitigation**




Note 1: Green route when evaluation is “yes”, blue route when evaluation is “no”.

# 4 Key assumptions for prediction of airborne noise during operation

With the exception of the revised road alignment (refer to **Section 2**) and the extent of the retained noise barriers (refer to **Section 4.1**), modelling inputs are assumed to be consistent with the EIS assessment (refer to **Section 5** of the noise and vibration technical paper).

The validated noise model used for the EIS noise assessment was used for this assessment.

## 4.1 Modelling of noise barriers – Build scenario without mitigation

Noise impacts are initially identified with existing noise barriers in place including relocated sections of existing noise barriers where required to accommodate the revised design of the project alignment. The retained noise barriers are shown in **Figure 4.1**.

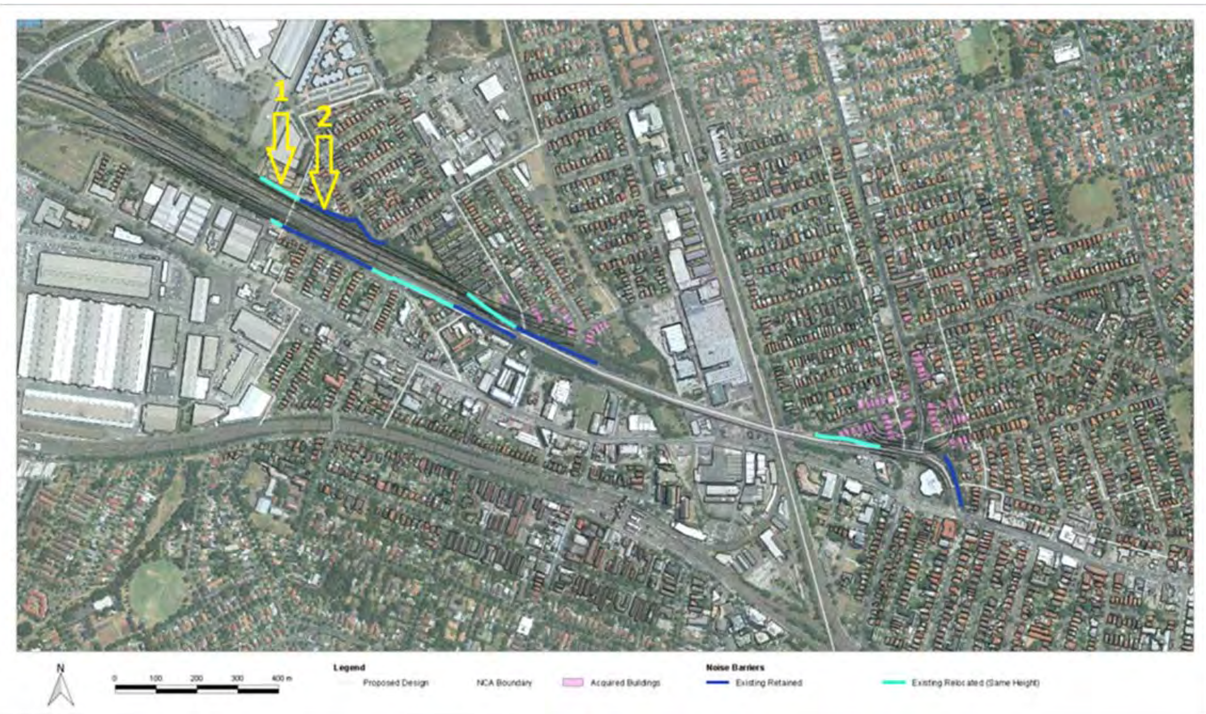



**Figure 4.1 Retained noise barriers**

Existing noise barriers have been relocated in the noise model maintaining the same absolute top of noise barrier height as the existing barriers. These sections are consistent with the EIS, with the following exceptions (refer to **Figure 4.1**):

- M4 EB noise barrier section adjacent to 9 Verley Drive is required to be relocated to make way for the revised design.
- The adjoining barrier section no longer encroaches on the revised design and has been retained as existing in the noise model (Build without additional mitigation).

New and/or modified noise barriers are considered as an additional noise mitigation measure where feasible and reasonable (refer to **Section 5.3**).

## 4.2 Model views

Views of the three dimensional noise models are presented in **Figure 4.2** and **Figure 4.3** for the EIS design and design change at Homebush Bay Drive respectively. Refer to **Section 2** for a description of the design change.

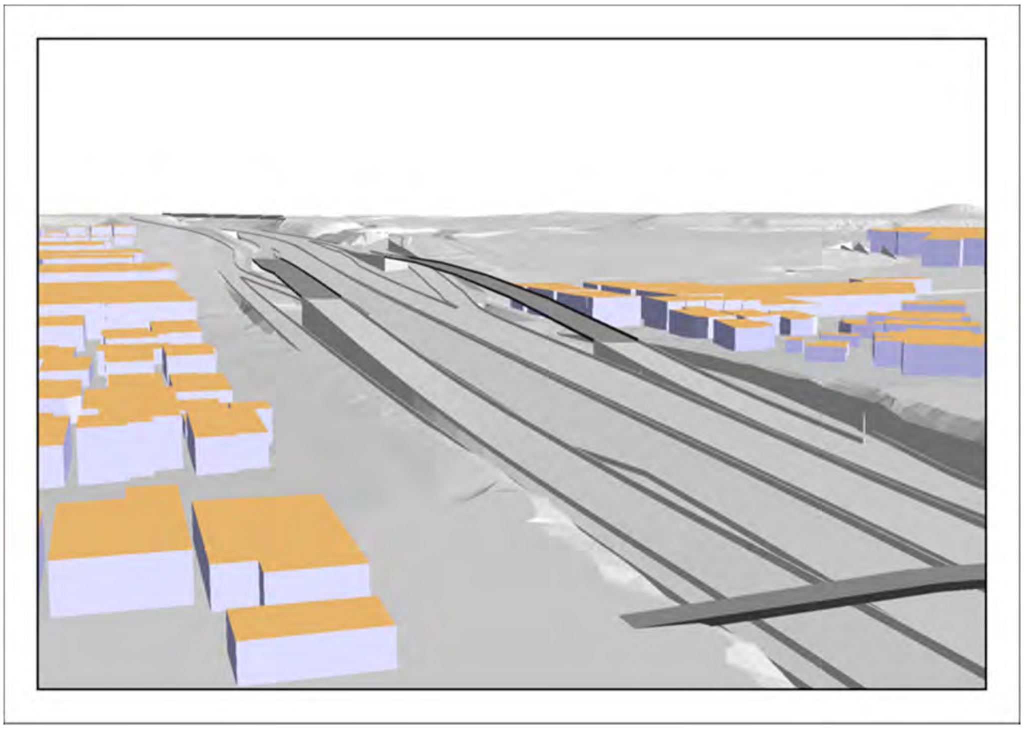


**Figure 4.2 Noise model view – EIS design, looking west towards Homebush Bay Drive interchange**

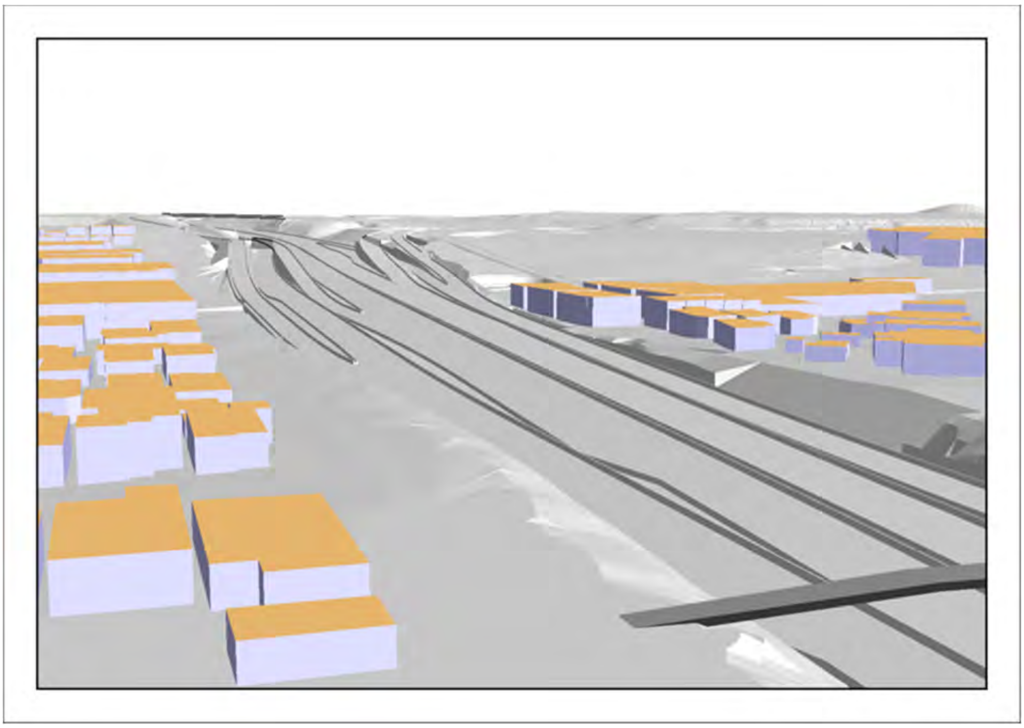


**Figure 4.3 Noise model view – Reconfigured design, looking west towards Homebush Bay Drive interchange**

## 4.3 Summary of noise modelling parameters

A summary of the modelling parameters, as taken from the EIS, is provided in **Table 4.1**.

**Table 4.1 Summary of baseline noise model inputs and parameters**

| Input Parameter | Source of Data | |
|---|---|---|
| Ground topography | Combination of surveyed road corridor data and LIDAR point cloud survey | |
| Proportion of absorbing ground | 0.5 (CORTN) | |
| Receiver Locations | Aerial photography and LIDAR point cloud | |
| Vehicle Speed<br>(2021 and 2031<br>Build and No Build) | Main carriageway<br>Existing access ramps<br>New ramps<br>New M4 East carriageway<br>New M4 carriageway west of M4 East portals<br>Secondary network roads | As sign posted<br>As sign posted<br>60 km/h<br>80 km/h<br>80 km/h<br>As sign posted |
| Source Heights and Source Correction (dB) | Car exhaust<br>Truck tyres<br>Truck engines<br>Truck exhausts | 0.5 m (0.0 dB)<br>0.5 m (-5.4 dB)<br>1.5 m (-2.4 dB)<br>3.6 m (-8.5 dB) |
| Road Surface Corrections (applied to all modelled source lines as a surface correction) | Existing M4 Carriageway<br>New M4 East Carriageway<br>New M4 Carriageway<br>New Ramps<br>Surrounding network roads | -2.0 dB[1]<br>0.0 dB[2]<br>0.0 dB[2]<br>0.0 dB<br>0.0 dB |
| Number and Location of sensitive receiver points | All sensitive receiver buildings, all facades and all floors, excluding facades shorter than 2.0 meters. Facade point located at the centre of the facade | |
| Congestion Corrections (applied to all modelled source lines as a surface correction in the No Build Scenario only) | M4 carriageway (day / night)<br>Parramatta Road (day / night)<br>Wattle Street (day / night)<br>Concord Road (day / night) | 0 / -2.1dBA<br>0 / 0<br>-1.4 / -1.4 dBA<br>-1.7 / -1.4 dBA |
| Receiver Location<br>(@ 1m from Facade) | Ground floor[3]<br>First floor[3] | 1.5 m<br>4.3 m |
| Facade Correction | +2.5 dB | |
| ARRB | -1.7 dBA for facade conditions<br>-0.7 dBA for free-field conditions | |
| $L_{A10}$ to $L_{Aeq}$ | -3 dBA | |
| $L_{Aeq(period)}$ to $L_{Aeq(1hour)}$ correction[4] | $L_{Aeq(15hour)}$ to $L_{Aeq(1hour)}$ +2.5 dBA<br>$L_{Aeq(9hour)}$ to $L_{Aeq(1hour)}$ +4.4 dBA | |

Note 1: Applied correction for OGA - refer to EIS noise and vibration technical paper.

Note 2: Low noise pavement is considered as additional noise mitigation where feasible and reasonable (refer to Section 5.2).

Note 3: These are typical heights above ground level, the height of some receivers was adjusted according to site survey information.

Note 4: Derived from monitoring data - refer to the EIS noise and vibration technical paper.

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# 5 Operational road traffic noise impact assessment

## 5.1 Operational noise impacts without mitigation

Predicted noise levels for all assessed scenarios are shown in **Appendix B** for the Build (without mitigation) scenario.

The 'without mitigation' noise predictions identify receivers which qualify for consideration of additional noise mitigation.

Noise levels in the No Build scenario are consistent with those reported in the EIS.

### 5.1.1 Difference in noise levels without mitigation

The predicted difference in noise levels (Build minus No Build) across NCA01 to NCA05 (ie the western end of the study area, adjacent to the design changes) is summarised **Figure 5.1** and **Figure 5.2** for the EIS design and revised design, respectively.

**Figure 5.1 Predicted change in noise levels (Build minus No Build) without mitigation – EIS Design**

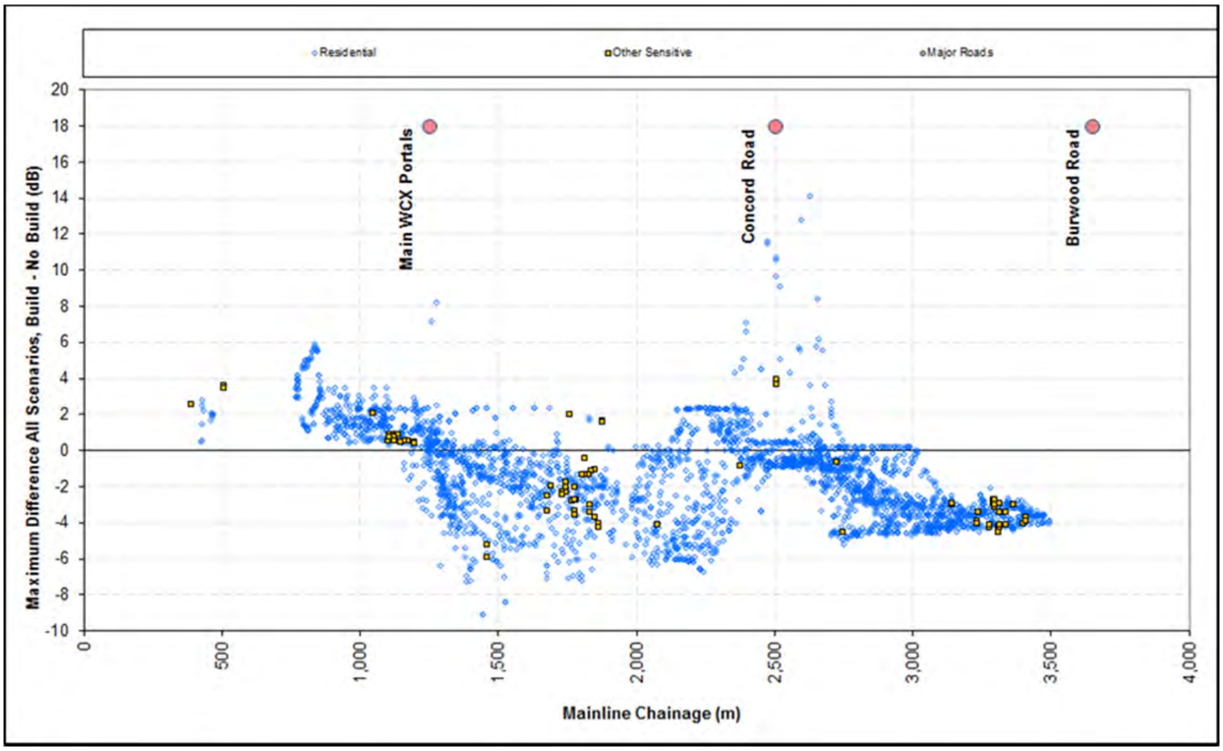
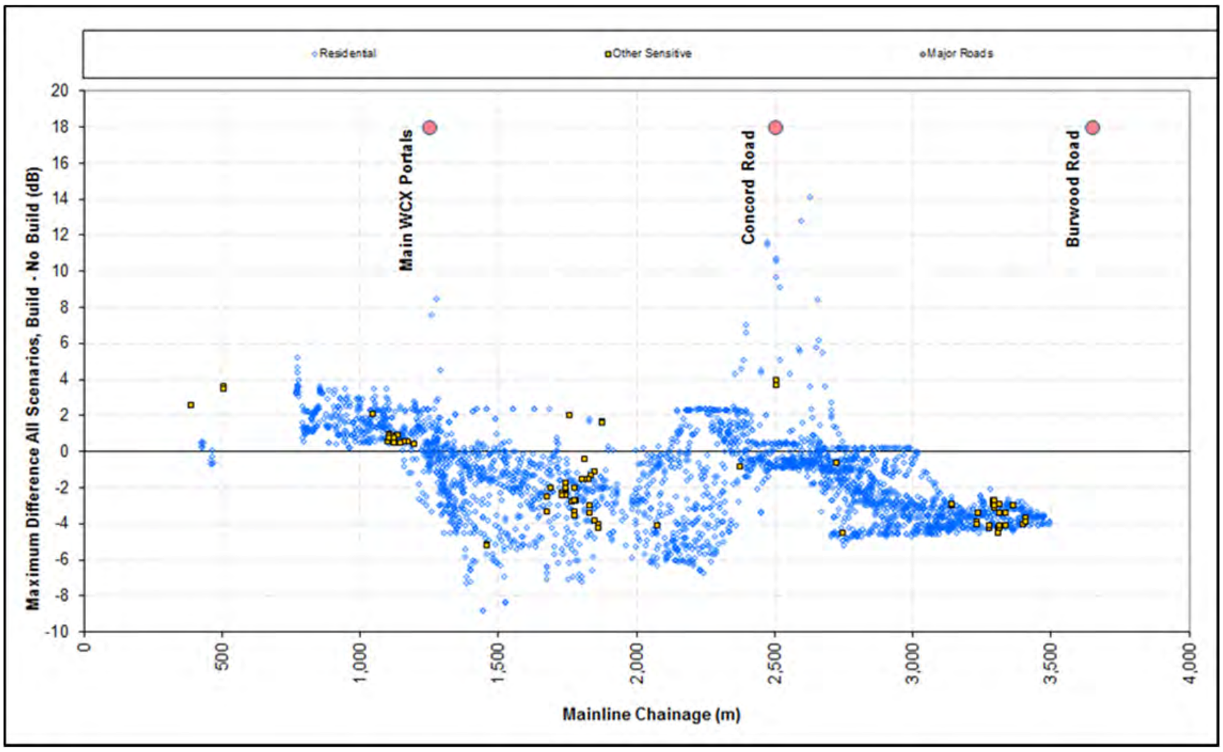


**Figure 5.2** **Predicted change in noise levels (Build minus No Build) without mitigation – Revised Design**




The information presented above indicates the following:

- The revised design is predicted to result in less of an increase in noise for receivers near chainage to 500 to 800. This location is adjacent to where the main design changes are proposed and is mainly due to the elevated bridge structure being removed.
- For the revised design, the change in noise levels for the remaining receivers is comparable to the EIS. This is due to no major design changes occurring in these locations.

## 5.2 Receivers considered for additional noise mitigation

Maps showing the location of receivers identified for consideration of additional noise mitigation (all assessment scenarios) are presented in **Appendix C**.

Further discussion of the project noise impacts (without mitigation) is presented in **Table 5.1**.

As per the EIS, this assessment counts each floor of properties as individual 'receivers'. Note that where multi-level residential buildings are apparent, counts for consideration of at-property treatment include the ground and first floor levels only. This is consistent with advice received from Roads and Maritime as it is generally not feasible and reasonable to provide at-receiver noise mitigation to multi-level residential receivers. Noise levels are assessed and outcomes referred to detailed design.

**Table 5.1 Summary of baseline noise model inputs and parameters**

| NCA | Receiver Type | Receiver floors (receiver lots) | EIS Receiver floors (receiver lots) | Comments |
|---|---|---|---|---|
| NCA01 | Residential | 33 (24) | 53 (31) | Reduction in triggered receivers from the EIS design due to revised alignment providing a more direct connection to the main carriageway for the eastbound on ramp from Homebush Bay Drive and also removing the need for the elevated bridge structure adjacent to Verley Drive. This effectively lowers the traffic noise sources and also increases the performance of the noise barriers to the north of the M4 (Verley Drive) compared to the elevated bridge structure in the EIS design. |
| | Other | 0 (0) | 0 (0) | |
| NCA02 | Residential | 22 (18) | 20 (17) | Minor increase in triggers due to minor changes in the Build (without additional mitigation) noise barrier footprint compared to the EIS (refer to **Section 4.1**) |
| | Other | 1 (1) | 1 (1) | |
| NCA03 | Residential | 36 (34) | 31 (29) | Increase in triggers compared to the EIS due to the raised alignment of the westbound off ramp to Homebush Bay Drive reducing the performance of the noise barriers to the south of the M4 together with removal of the embankment on the approach to the elevated bridge structure which was previously providing some degree of screening. |
| | Other | 4 (3) | 4 (3) | |
| NCA04 | Residential | 0 (0) | 0 (0) | No change from EIS assessment |
| | Other | 5 (4) | 5 (4) | |
| NCA05 | Residential | 11 (6) | 11 (6) | No change from EIS assessment |
| | Other | 3 (2) | 3 (2) | |
| **TOTAL** | | **115 (92)** | **128 (93)** | Reduction of 13 triggered receivers compared to the EIS design. |

## 5.3 Additional noise mitigation – low noise pavement

Low noise pavement has been considered for the surface sections of the M4 East carriageway and modified sections of the M4 carriageway. Other roads within the study area have not been considered for a low noise pavement due to lower vehicle speeds and/or operational constraints regarding pavement type as discussed in Section 7.2 of the EIS noise and vibration technical paper.

Of the receivers eligible for consideration of additional noise mitigation (refer to **Section 5.1**), receivers which remain above the NCG controlling criterion after the benefit of low noise pavement are eligible for consideration of further additional noise mitigation and are identified in **Appendix D**.

Installation of the proposed low noise pavements is predicted to reduce noise levels by up to 2 dBA with the result that 16 receivers (total number of individual floors) no longer require consideration of further additional noise mitigation (noise barriers).

Low noise pavements are subject to further considerations during detailed design.

## 5.4 Additional noise mitigation – noise barriers

The noise barrier optimisation process is based on guidance in the NMG as discussed in **Section 3**. The optimisation results are detailed in **Appendix E** with the assessed barriers identified in **Figure 5.3** and recommendations summarised in **Table 5.2**.

The overall extent of barriers is consistent with the EIS, noting that the revised design creates an opportunity to retain an additional section of NW_M4EB_01C (existing) which was previously required to be relocated. The revised design of the eastbound on ramp form Homebush Bay Drive requires NW_M4EB_01B to now be relocated. The optimised height of NW_M4EB_01E for the revised design is 3.5 metres, which is 0.5 metres lower than the EIS recommended barrier.

While the assessment has identified these potential barriers as additional noise mitigation, the recommended barriers are subject to further considerations during detailed design such as construction limitations, overshadowing, urban design and community preference.

Installation of the proposed noise barriers is predicted to reduce noise levels in such away that 38 receivers (total number of individual floors) no longer require consideration of further noise mitigation (at-property treatment).

**Figure 5.3 Predicted change in noise levels (Build minus No Build) without mitigation – Revised Design**

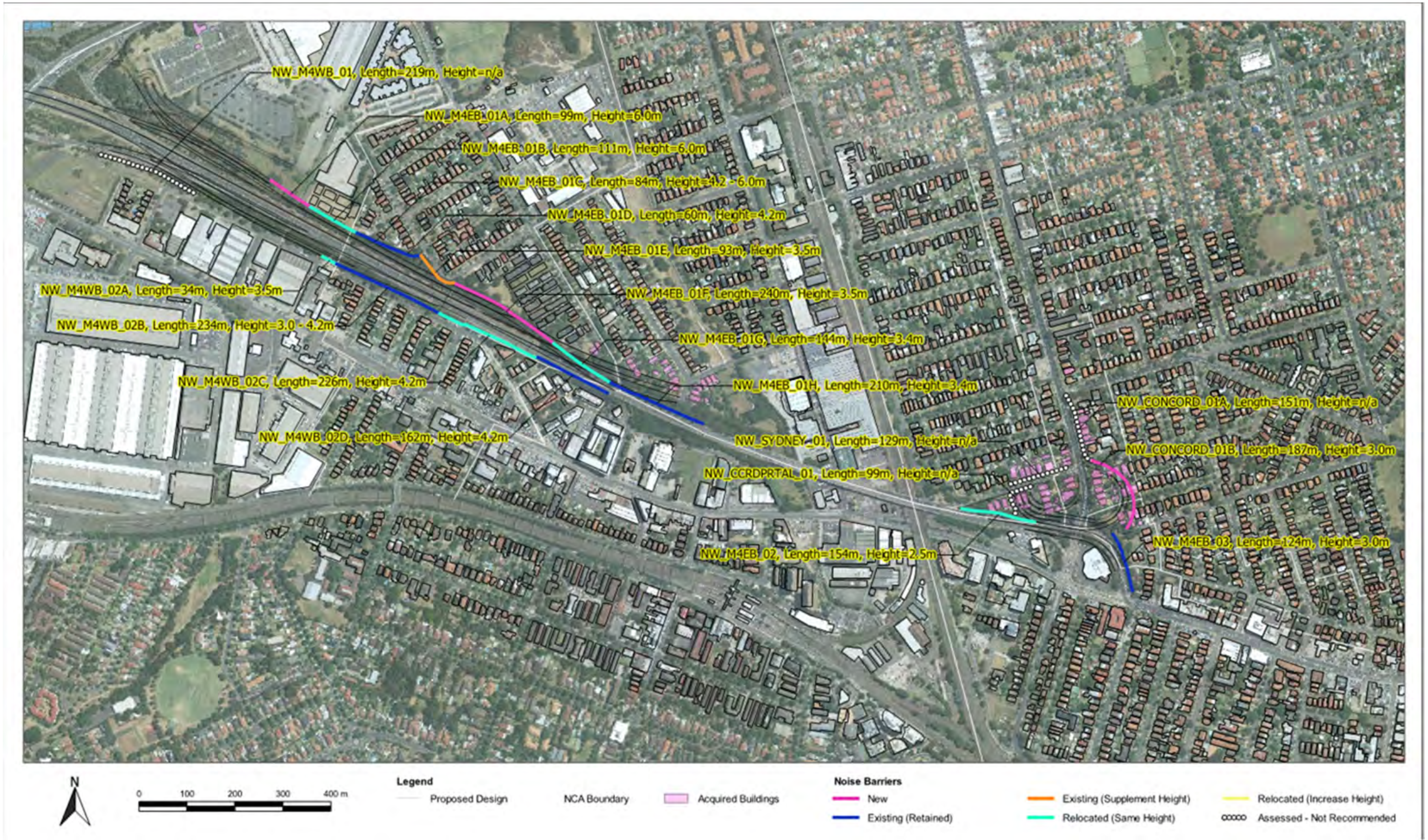


**Table 5.2 Summary of baseline noise model inputs and parameters**

| Barrier Reference | Existing Barrier Height1 (m) | Noise Barrier Details2 | | | EIS Noise Barrier Details | | | Comments of Revised Design of Barriers |
|---|---|---|---|---|---|---|---|---|
| | | Type | Length (m) | Height (m) | Type | Length (m) | Height (m) | |
| NW_M4EB_01A | - | New | 99 | 6.0 | New | 100 | 6.0 | Maximum and Optimised design height 7.5 m. Initial design height of 6.5 m. Most receivers achieve an IL of more than 10 dBA with the initial design height. The Initial design height reduces triggers to 2/3 of those that can be eliminated between 0 m and the maximum height barrier. Whist there may be benefits in erecting a 7.5 m high barrier, a 6.0 m high barrier has been adopted for the EIS as the feasibility of a higher barrier will be investigated further in detailed design. Therefore recommended to retain the existing barrier section where practicable and install a new extension to the west at 6.0 metres height subject to further feasibility investigations during detailed design. |
| NW_M4EB_01B | 6.0 | Existing Relocated | 111 | 6.0 | Existing Retained / Existing Relocated | 80 | 6.0 | |
| NW_M4EB_01C | 4.2 to 6.0 | Existing Retained | 84 | 4.2 to 6.0 | Existing Relocated | 116 | 4.2 to 6.0 | Maximum design height of 8.0 m. Initial and Optimised design height of 3.5 m. The Optimised design height reduces triggers to 2/3 of those that can be eliminated between 0 m and the maximum height barrier. The maximum height barrier is unlikely to be within 125% of the cost of treatments with the Optimised design height. Therefore recommend retain existing NW_M4EB_01C and NW_M4EB_01D (higher than optimised design height) and increase height of NW_M4EB_01E to 3.5 m (more than 2 dBA improvement in IL over existing 2.1 m barrier). |
| NW_M4EB_01D | 4.2 | Existing Retained | 60 | 4.2 | Existing Retained | 60 | 4.2 | |
| NW_M4EB_01E | 2.1 | Existing Increase | 93 | 3.5 | Existing Increase | 93 | 4.0 | |
| NW_M4EB_01F | - | New | 240 | 3.5 | New | 240 | 3.5 | Consistent with EIS. |
| NW_M4EB_01G | 3.4 | Existing Relocated | 144 | 3.4 | Existing Relocated | 144 | 3.4 | Consistent with EIS. |
| NW_M4EB_01H | 3.4 | Existing Retained | 210 | 3.4 | Existing Retained | 210 | 3.4 | Consistent with EIS. |

| Barrier Reference | Existing Barrier Height1 (m) | Noise Barrier Details2 Type | Length (m) | Height (m) | EIS Noise Barrier Details Type | Length (m) | Height (m) | Comments of Revised Design of Barriers |
|---|---|---|---|---|---|---|---|---|
| NW_M4EB_02 | 2.5 | Existing Retained / Existing Relocated | 154 | 2.5 | Existing Retained / Existing Relocated | 154 | 2.5 | Consistent with EIS. |
| NW_M4EB_03 | 3.0 | Existing Retained | 124 | 3.0 | Existing Retained | 124 | 3.0 | Consistent with EIS. |
| NW_M4WB_01 | - | New not reasonable | 219 | n/a | New not reasonable | 219 | n/a | Maximum design height 5.0 m (due to noise levels at triggered receivers being limited by flanking around the side of the noise barrier). Initial and Optimised design height of 5.0 m. No receivers achieve an IL of 5 dBA with the Optimised design height. The Optimised design height eliminates only one property treatment with a 219 m noise barrier.<br>Therefore barrier is not considered reasonable, so at-property treatments for the triggered receivers are recommended instead of a barrier. |
| NW_M4WB_02A | 3.5 | Existing Relocated | 34 | 3.5 | Existing Relocated | 34 | 3.5 | Maximum design height 8.0 m. Initial and Optimised design height of 5.5 m. No receivers achieve an IL of 10 dBA with the Optimised design height. Benefiting receivers achieve a mixture of 2 and 5 dBA IL.<br>Therefore recommend retention of existing barrier. |
| NW_M4WB_02B | 3.0 to 4.2 | Existing Retained | 234 | 3.0 to 4.2 | Existing Retained | 234 | 3.0 to 4.2 | |
| NW_M4WB_02C | 4.2 | Existing Relocated | 226 | 4.2 | Existing Relocated | 226 | 4.2 | Maximum design height 8.0 m. No reduction in triggers at any barrier height.<br>Recommend relocated barrier no lower than the existing RL top of barrier height (varying up to 4.2 m) at any relocated section. |
| NW_M4WB_02D | 4.2 | Existing Retained | 162 | 4.2 | Existing Retained | 162 | 4.2 | No further assessment (not more than three closely spaced triggered receivers) |

Note 1: Existing height is the height of the existing or the replaced existing noise barrier (ie maintaining the same top of noise barrier height as the existing barrier)

Note 2: Recommended height is subject to further considerations during detailed design such as construction limitations, overshadowing, urban design and community preference.

## 5.5 Operational noise impacts with mitigation

Predicted noise level maps showing noise levels at all residential receiver buildings for the Build (with mitigation) scenarios are provided in **Appendix F**.

The 'without mitigation' noise predictions are used to identify receivers which qualify for consideration of at-property treatment.

### 5.5.1 Receivers considered for at-property treatment

With reference to the criteria for additional mitigation (refer to **Section 3**), the number of receivers which have been identified as eligible for consideration of property treatments after additional noise mitigation (low noise pavement and noise barriers) are shown in **Table 5.3**.

**Table 5.3 Receivers considered eligible for at-property treatment**

| NCA | Receiver Type | 2021 Final Build | | | 2031 Final Build | | | TOTAL | | EIS Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Night | Combined | Day | Night | Combined | By Floor | By Lot | By Floor | By Lot |
| NCA01 | Residential | - | - | - | 18 | 19 | 19 | 19 | 19 | 22 | 22 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| NCA02 | Residential | 1 | - | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Other | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| NCA03 | Residential | 4 | 10 | 10 | 13 | 30 | 30 | 30 | 29 | 26 | 25 |
| | Other | - | - | - | 4 | - | 4 | 4 | 3 | 4 | 3 |
| NCA04 | Residential | - | - | - | - | - | - | - | - | - | - |
| | Other | 3 | - | 3 | 5 | - | 5 | 5 | 4 | 5 | 4 |
| NCA05 | Residential | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 6 | 11 | 6 |
| | Other | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 |
| TOTAL | | | | | | | | 77 | 68 | 76 | 67 |

The information presented in **Table 5.3** indicates that the revised Homebush Bay drive interchange design, in conjunction with the recommended additional noise mitigation, results in a negligible change in the total number of at-property treatments for the project (one receiver more than the EIS). This is due to the following:

The revised alignment provides a more direct connection to the main carriageway for the eastbound on ramp from Homebush Bay Drive and also removes the need for the elevated bridge structure adjacent to Verley Drive, thereby reducing the impacts in NCA01

Slightly reduced performance of the noise barriers in NCA02 for the new alignment compared to the barrier and alignment configuration of the EIS design in this area.

The locations of the receivers eligible for consideration of property treatment are shown in the maps in **Appendix G**. These receivers correspond to those eligible for consideration of additional noise mitigation where the feasible and reasonable mitigation does not reduce the noise levels to meet the NCG controlling criterion.

## 5.6 Discussion of at-property treatments

For individual residential receivers Roads and Maritime does not consider it reasonable to consider noise mitigation above the ground and first floor.

Refer to **Section 7.4** and **Section 7.5** in the noise and vibration technical paper for discussion of applicable at-property treatments for these groups, noting that the finalised requirement for treatment would be confirmed during detailed design, following property inspections as required.

## 5.7 Maximum noise levels

Indicative increases in maximum noise levels were evaluated based on an elevated source height corresponding to the height of a truck exhaust.

Evaluation of the potential increase in maximum noise levels indicates that maximum noise level events may increase at residential receivers in the following locations:

- NCA01 North – Receivers north of the M4 adjacent to the new eastbound M4 carriageway where the carriageway has moved closer to the receivers. Increases of up to 8 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project (refer to **Section 5.5.1**).
- NCA01 South – Receivers south of the M4 adjacent to the new westbound M4 flyover where the raised carriageway has increased line of sight to elevated heavy vehicle exhausts on the new flyover. Increases of up to 12 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.
- NCA02 – Receivers north of the M4 adjacent to the new eastbound M4 onramp where the carriageway has moved closer to the receivers. Increases of up to 4 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.
- NCA03 – Receivers south of the M4 adjacent to the new M4 carriageway where the carriageway has moved closer to the receivers. Increases of up to 3 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.
- NCA04 – Receivers north of the M4 across from the new westbound on ramp at Powell Street. Increases of up to 1 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.
- NCA03 – Receivers south of the M4 adjacent to the new westbound on ramp at Powell Street. Increases of up to 3 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.

**Table 5.4 Comparison of EIS LAmax noise levels to this assessment**

| NCA | EIS LAmax Assessment | This LAmax Assessment |
|---|---|---|
| NCA01 North | Increases of up to 13 dBA | Increases of up to 8 dBA |
| NCA01 South | Increases of up to 3 dBA | Increases of up to 12 dBA |
| NCA02 | Increases of up to 11 dBA | Increases of up to 4 dBA |
| NCA03 | Increases of up to 10 dBA | Increases of up to 3 dBA |
| NCA04 | Increases of up to 1 dBA | Increases of up to 1 dBA |
| NCA05 | Increases of up to 4 dBA | Increases of up to 4 dBA |

Compared to the EIS LAmax assessment the magnitude of maximum noise level events has decreased in NCA01 North, NCA02 and NCA03 due to the new M4 flyovers being moved further to the west. The magnitude of maximum noise level events has increased in NCA01 South as the new M4 flyovers have moved closer to these receivers. The magnitude of maximum noise level events has not changed in NCA04 and NCA05.

The proposed noise barrier designs (refer to **Section 5.4**) are predicted to reduce the noise level of maximum noise level events for receivers which benefit from new or increased height barriers with no change to the field of view to the road. These benefits are mainly in receiver areas to the north of the M4 in NCA02 and NCA04.

Some receivers as identified in the points above may experience an increase in magnitude of maximum noise events due to changes in view to the road alignment. The noise barrier optimisation process (refer to **Section 5.4**) does not account for changes in magnitude of the LAFmax noise events. It is therefore recommended that detailed investigation of maximum noise levels due to the project should be undertaken during detailed design, including consideration of feasible and reasonable noise mitigation on the basis of maximum noise levels.

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# 6 Conclusion

In relation to noise impacts, the proposed design changes at the Homebush Bay Drive interchange have been found to vary from the EIS assessment as follows:

- The revised alignment provides a more direct connection to the main carriageway for the eastbound on ramp from Homebush Bay Drive and also removes the need for the elevated bridge structure adjacent to Verley Drive. These changes benefit receivers in NCA01 to the north of the M4 (Verley Drive) due to improved noise barrier effectiveness
- Increased elevation of the westbound off ramp to Homebush bay Drive resulting in reduced noise barrier effectiveness to receivers to the south of the M4 in NCA03
- The assessment of operational noise impacts was undertaken using the methodology adopted in the EIS. Modelling inputs differences between this assessment and the EIS are limited to the alignment of the revised design and the Build (without additional mitigation) noise barriers which reflect the revised footprint of the road alignment.

Differences between the predicted noise impacts for the revised design and that assessed in the EIS result in the follows changes to the proposed noise mitigation:

- Overall reduction in receivers eligible for consideration of additional noise mitigation for the revised design, controlled by the reduction in triggers in NCA01 (Verley Drive)
- Noise barrier NW_M4EB_01B is required to be relocated (height is consistent with the EIS recommendation)
- Noise barrier NW_M4EB_01C is retained at existing height (previously required to be relocated for the EIS design)
- Noise barrier NW_M4EB_01E is recommended at 3.5 metre height (previously 4.0 metres)
- Marginal change in overall number of receivers eligibly for consideration of at-property treatments (increase of one receiver compared to the EIS assessment)
- Lower maximum noise levels by approximately 5 dB to 7 dB compared to the EIS assessment at the most affected receivers in NCA01 North, NCA02 and NCA03 due to the new M4 flyovers being moved further to the west with the revised design
- Higher maximum noise levels by approximately 9 dB compared to the EIS assessment at the most affected receivers in NCA01 South as the new M4 flyovers have moved closer to these receivers with the revised design
- Maximum noise levels at the most affected receivers in NCA04 and NCA05 are similar to the EIS assessment.

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# WESTCONNEX M4 EAST
# OPERATIONAL ROAD TRAFFIC NOISE IMPACT ASSESSMENT
# DESIGN CHANGE - WATTLE STREET (CITY WEST LINK) INTERCHANGE

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# 1 Introduction

## 1.1 Background

Noise and vibration impacts during operation of the M4 East project have been assessed and reported in the noise and vibration technical paper (SLR report reference 610.13569-R2 dated 4 September 2015), included as part of the project's Environmental Impact Statement (EIS).

Since completion of the EIS, an alternative interchange arrangement at Wattle Street (City West Link) has been proposed.

This change in alignment requires additional assessment as it is likely to change the predicted noise impacts at the surrounding noise-sensitive receivers when compared to the EIS assessment.

## 1.2 Scope of this report

SLR has been engaged by Sydney Motorway Corporation (SMC) to assess potential noise impacts due to the proposed new alignment at Wattle Street.

This report forms an addendum to the EIS noise and vibration technical paper and presents a summary of the operational road traffic noise impacts of the proposed new alignment at Wattle Street.

This report presents the results from the re-assessment of the proposed revised alignment. As such it should be read in conjunction with the EIS noise and vibration technical paper which contains detailed descriptions and explanations on the assessment guidelines and methodologies used.

## 1.3 Guidelines

Consistent with the EIS noise and vibration technical paper the following guidelines have been used for this assessment:

- Noise from the operation of the proposal is assessed in accordance with guidelines provided in the NSW Road Noise Policy (RNP) ((NSW) Environment Protection Agency (EPA), 2011) as interpreted by Roads and Maritime in the Noise Criteria Guideline (NCG) (Roads and Maritime, 2014)
- Guidance for additional noise mitigation is taken from the Noise Mitigation Guideline (NMG) (Roads and Maritime, 2014)
- Guidance for assessing the potential for sleep disturbance from maximum noise events is taken from Practice Note iii in the Environmental Noise Management Manual (ENMM) (Roads and Maritime, 2001).

## 1.4 Terminology

The assessment has used specific acoustic terminology throughout. An explanation of common terms is included as **Appendix A** for reference.

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# 2 Design change – Wattle Street (City West Link) interchange

## 2.1 Description of change

In the EIS, the Wattle Street (City West Link) interchange included separate cut and cover tunnel structures.

As a result of ongoing design development, the configuration of the Wattle Street interchange is proposed to be modified. The purpose of these changes is to combine the dive and cut and cover structures for both the M4 East ramps and the M4–M5 Link ramps.

The below sections outline the proposed changes to the configuration of the interchange. The new arrangement is shown in **Figure 2.1.**

There would also be changes to subsurface property acquisition.

### 2.1.1 M4 East tunnel exit to Wattle Street

The M4 East tunnel exit to Wattle Street would not be altered significantly. The tunnel portal would remain on the northern side of Ramsay Street.

The dedicated right turn bay at the Waratah Street signalised intersection would remain for traffic exiting the eastbound mainline tunnel only.

### 2.1.2 M4 East tunnel entrance from Wattle Street

The M4 East tunnel entry from Wattle Street would be relocated further to the east, so that the on-ramp would be the eastern-most (kerbside) lane while the surface Wattle Street would continue in the centre lanes. The dive structure for this on-ramp would start on the southern side of Martin Street. The tunnel portal would remain on the northern side of Ramsay Street.

There would be no other change to the on-ramp.

### 2.1.3 Wattle Street surface adjustments

The surface Wattle Street eastbound lanes would not change as part of the modification of the interchange.

The surface Wattle Street westbound lanes would be realigned to the east of its existing alignment; however, it would continue in the centre lanes (instead of the kerbside lanes as described in the EIS). To do this, the surface lanes would travel over the cut and cover sections of the M4–M5 Link on- and off-ramps.

South of Ramsay Street, the westbound surface Wattle Street lanes would still split as described in the EIS, two separate sets of lanes providing access to Parramatta Road westbound, and Parramatta Road eastbound or Frederick Street southbound.

North of Waratah Street, the surface works would remain on the same general alignment.

**Martin Street**

As the westbound kerbside lane would be for the M4 East on-ramp, it is proposed to permanently close the eastern side of Martin Street at Wattle Street and provide a cul-de-sac.

### 2.1.4 M4–M5 Link on- and off-ramps tunnels

The M4-M5 Link cut and cover structures would start in about the same location as described in the EIS, but would be realigned so that they are positioned between the M4 East on- and off-ramps. The on- ramp dive structure would be lengthened, while the off-ramp dive structure would be shortened.


**Figure 2.1 Reconfigured Wattle Street (City West Link) interchange**

# 3 Operational noise goals and noise mitigation guidance

This assessment is undertaken with guidance from the NCG. The NCG documents Roads and Maritime's interpretation of the RNP. This is consistent with the approach taken in the EIS noise and vibration technical paper.

## 3.1 Guidance for consideration of reasonable additional noise mitigation

The NMG provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the adoption of road design and traffic management measures). These are:

**Trigger 1**

- The predicted Build noise level exceeds the NCG controlling criterion and the noise level increase due to the project (ie the noise predictions for the Build minus the No-Build) is greater than 2 dBA

**Trigger 2**

- The predicted Build noise level is 5 dBA or more above the criteria (exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the project

**Trigger 3**

- The noise level contribution from the road project is acute (daytime LAeq(15hour) 65 dBA or higher, or night-time LAeq(9hour) 60 dBA or higher) qualifying for consideration of noise mitigation even if noise levels are dominated by another road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the benefit of additional noise mitigation (low noise pavement and noise barriers) is included. The requirement for the project is to provide feasible and reasonable additional mitigation for these eligible receivers to meet the NCG controlling criterion. If the NCG criterion cannot be satisfied with low noise pavement and noise barriers, then the receiver is eligible for consideration of at-property treatment.

Further detail on the process of applying the NMG is presented in the EIS noise and vibration technical paper.

The NMG process is summarised in the flowchart in **Figure 3.1**.

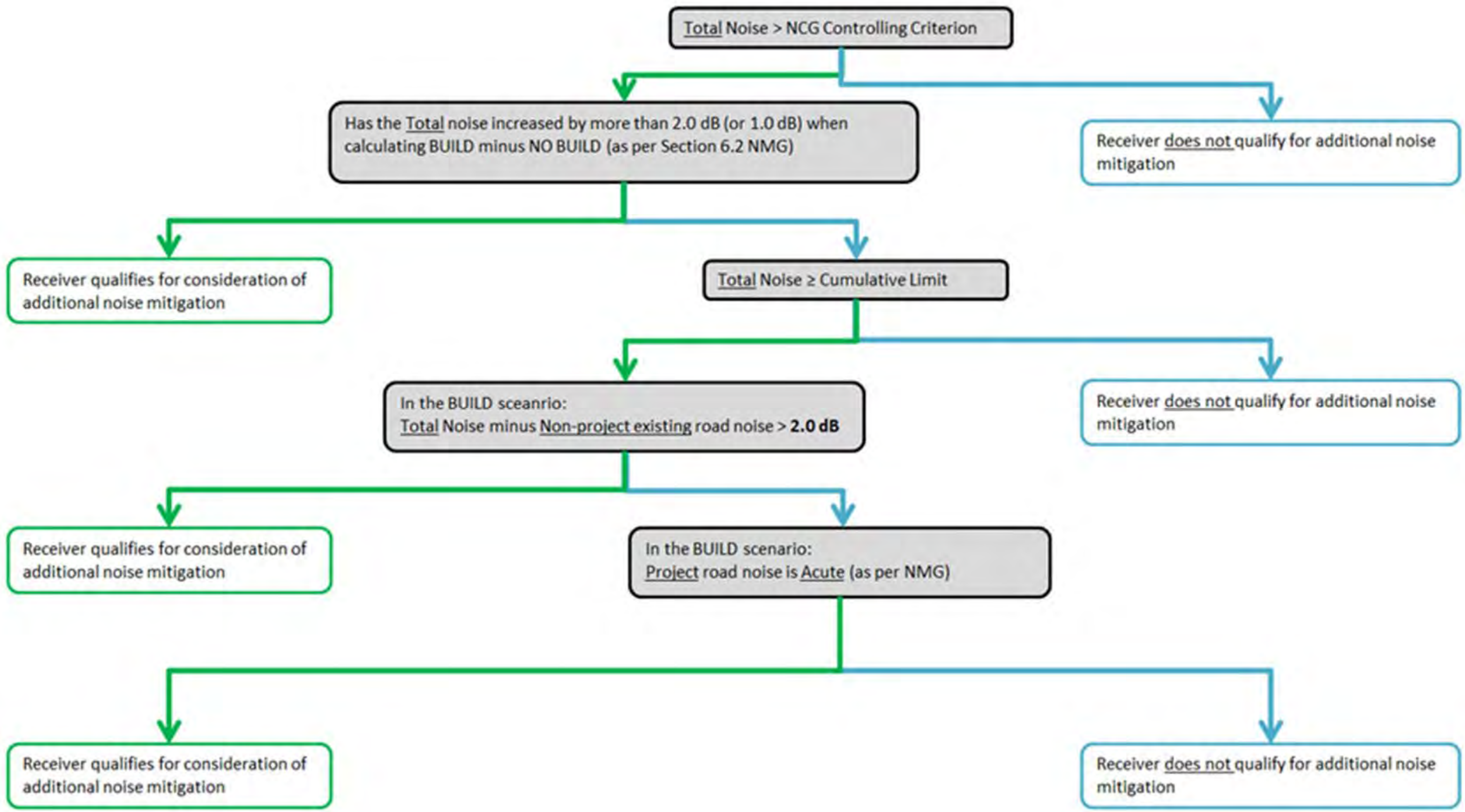


**Figure 3.1 Flowchart - Reasonable and feasible noise mitigation (NMG)**

Note 1: Green route when evaluation is “yes”, blue route when evaluation is “no”.

# 4 Key assumptions for prediction of airborne noise during operation

With the exception of the revised road alignment (refer to **Section 2**), modelling inputs are assumed to be consistent with the EIS assessment (refer to **Section 5** of the noise and vibration technical paper).

The validated noise model used for the EIS noise assessment was used for this assessment.

## 4.1 Model views

Views of the three dimensional noise models are presented in **Figure 4.1** and **Figure 4.2** for the EIS design and design change at Wattle Street respectively. Refer to **Section 2** for a description of the design change.

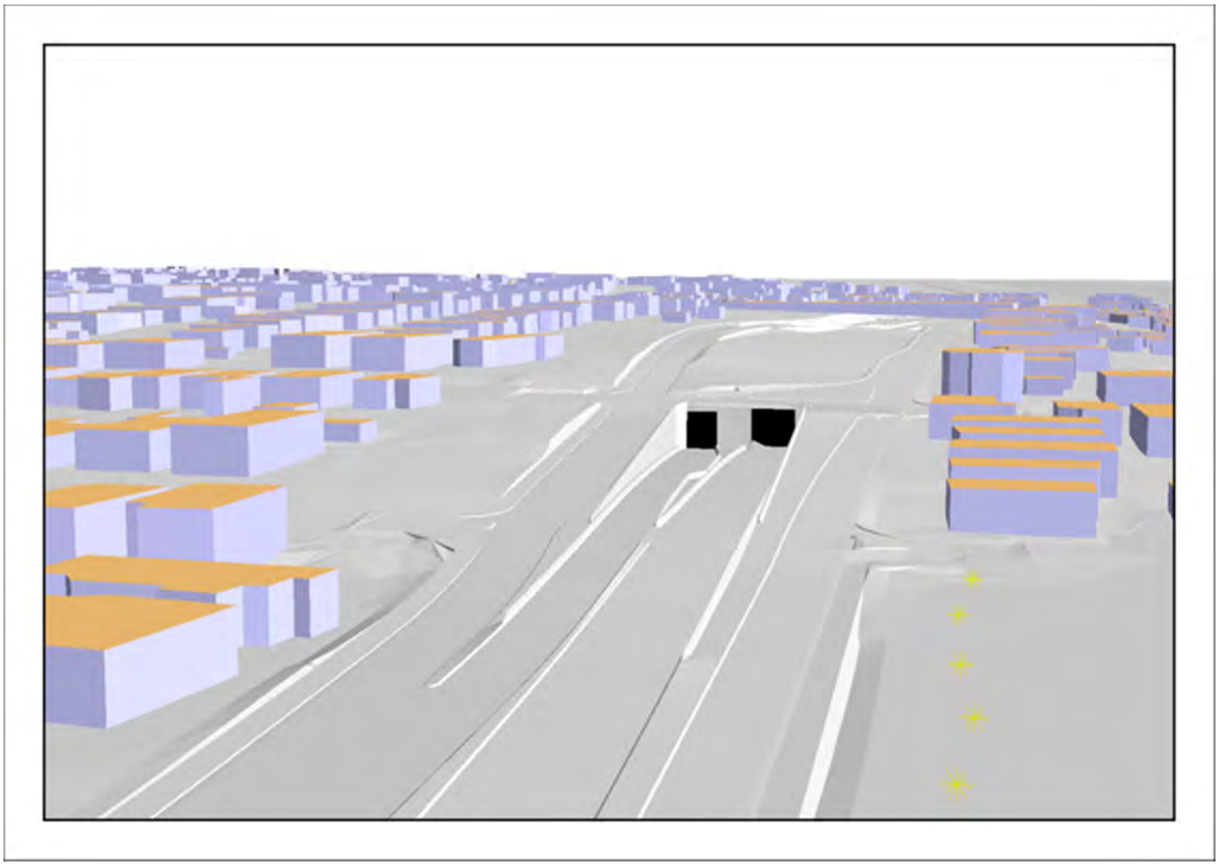

**Figure 4.1 Noise model view – EIS design at Wattle Street interchange**

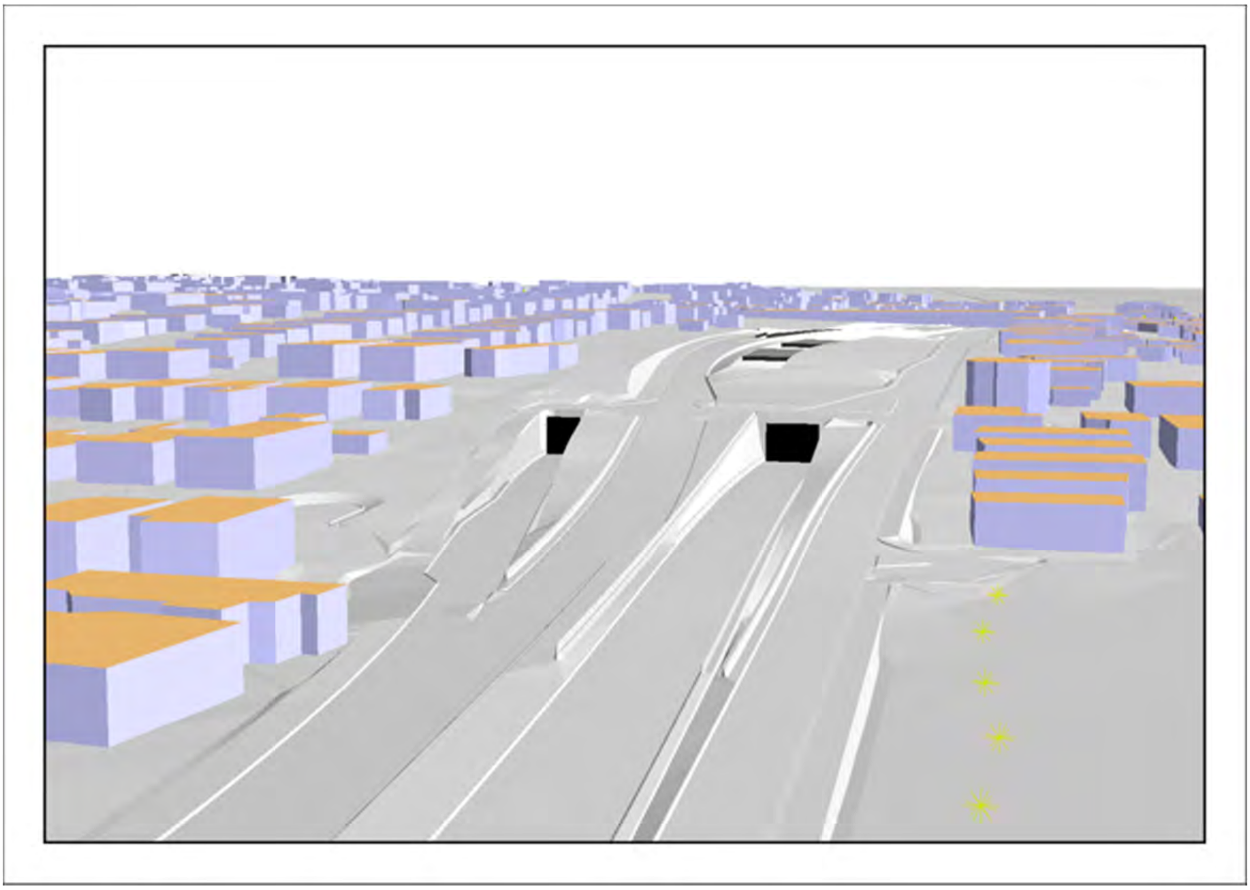

**Figure 4.2 Noise model view - design change at Wattle Street interchange**

## 4.2 Summary of noise modelling parameters

A summary of the modelling parameters, as taken from the EIS, is provided in **Table 4.1**.

**Table 4.1 Summary of baseline noise model inputs and parameters**

| Input Parameter | Source of Data | |
|---|---|---|
| Ground topography | Combination of surveyed road corridor data and LIDAR point cloud survey | |
| Proportion of absorbing ground | 0.5 (CORTN) | |
| Receiver Locations | Aerial photography and LIDAR point cloud | |
| Vehicle Speed (2021 and 2031 Build and No Build) | Main carriageway<br>Existing access ramps<br>New ramps<br>New M4 East carriageway<br>New M4 carriageway west of M4 East portals<br>Secondary network roads | As sign posted<br>As sign posted<br>60 km/h<br>80 km/h<br>80 km/h<br>As sign posted |
| Source Heights and Source Correction (dB) | Car exhaust<br>Truck tyres<br>Truck engines<br>Truck exhausts | 0.5 m (0.0 dB)<br>0.5 m (-5.4 dB)<br>1.5 m (-2.4 dB)<br>3.6 m (-8.5 dB) |

| Input Parameter | Source of Data | |
|---|---|---|
| Road Surface Corrections (applied to all modelled source lines as a surface correction) | Existing M4 Carriageway<br>New M4 East Carriageway<br>New M4 Carriageway<br>New Ramps<br>Surrounding network roads | -2.0 dB[1]<br>0.0 dB[2]<br>0.0 dB[2]<br>0.0 dB<br>0.0 dB |
| Number and Location of sensitive receiver points | All sensitive receiver buildings, all facades and all floors, excluding facades shorter than 2.0 meters. Facade point located at the centre of the facade | |
| Congestion Corrections (applied to all modelled source lines as a surface correction in the No Build Scenario only) | M4 carriageway (day / night)<br>Parramatta Road (day / night)<br>Wattle Street (day / night)<br>Concord Road (day / night) | 0 / -2.1dBA<br>0 / 0<br>-1.4 / -1.4 dBA<br>-1.7 / -1.4 dBA |
| Receiver Location (@ 1m from Facade) | Ground floor[3]<br>First floor[3] | 1.5 m<br>4.3 m |
| Facade Correction | +2.5 dB | |
| ARRB | -1.7 dBA for facade conditions<br>-0.7 dBA for free-field conditions | |
| $L_{A10}$ to $L_{Aeq}$ | -3 dBA | |
| $L_{Aeq(period)}$ to $L_{Aeq(1hour)}$ correction[4] | $L_{Aeq(15hour)}$ to $L_{Aeq(1hour)}$ +2.5 dBA<br>$L_{Aeq(9hour)}$ to $L_{Aeq(1hour)}$ +4.4 dBA | |

Note 1: Applied correction for OGA - refer to EIS noise and vibration technical paper.

Note 2: Low noise pavement is considered as additional noise mitigation where feasible and reasonable (refer to **Section 5.2**).

Note 3: These are typical heights above ground level, the height of some receivers were adjusted according to site survey information.

Note 4: Derived from monitoring data - refer to the EIS noise and vibration technical paper.

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# 5 Operational road traffic noise impact assessment

## 5.1 Operational noise impacts without mitigation

Predicted noise levels for all assessed scenarios are shown in **Appendix B** for the Build (without mitigation) scenario.

The 'without mitigation' noise predictions identify receivers which qualify for consideration of additional noise mitigation.

Noise levels in the No Build scenario are consistent with those reported in the EIS.

### 5.1.1 Change in noise levels without mitigation

The predicted change in noise levels (Build minus No Build) across NCA13 to NCA18 (ie the areas surrounding Wattle Street, adjacent to the design changes) are summarised **Figure 5.1** and **Figure 5.2**, for the EIS design and the revised design, respectively.

**Figure 5.1 Predicted change in noise levels (Build minus No Build) without mitigation – EIS Design**

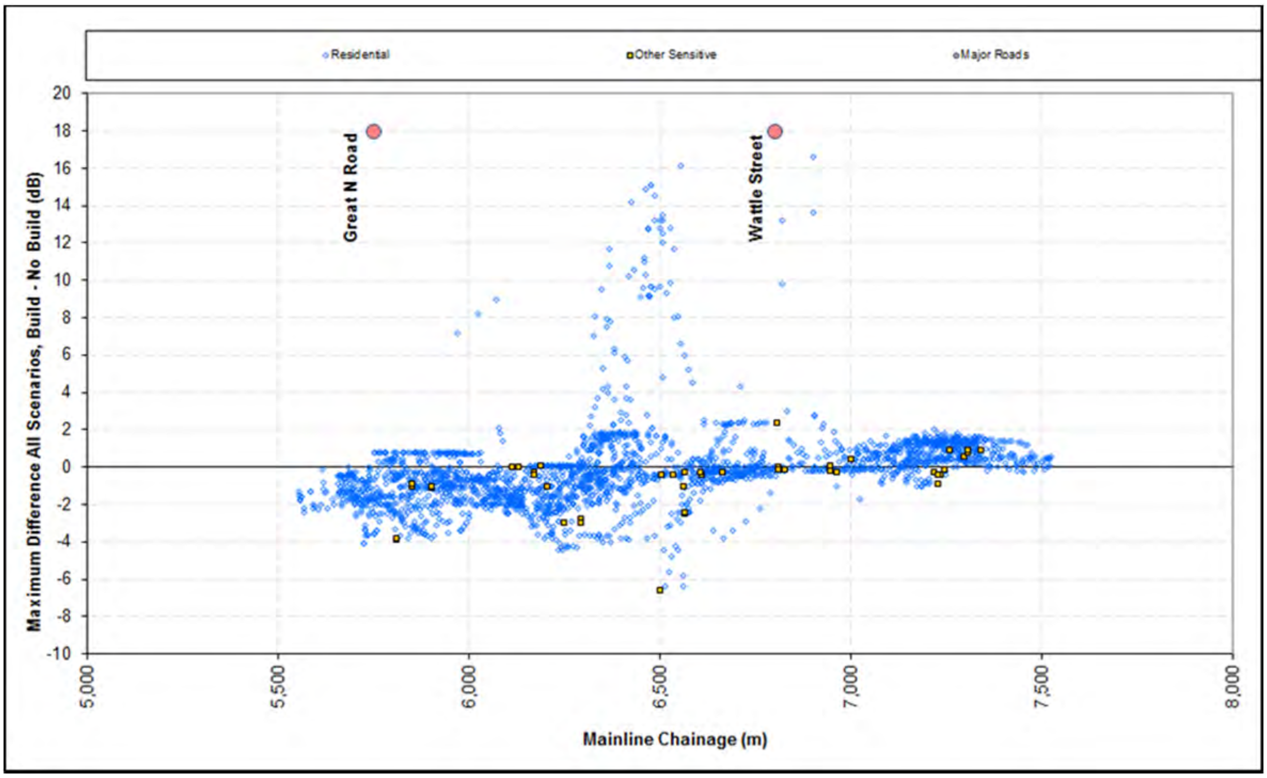
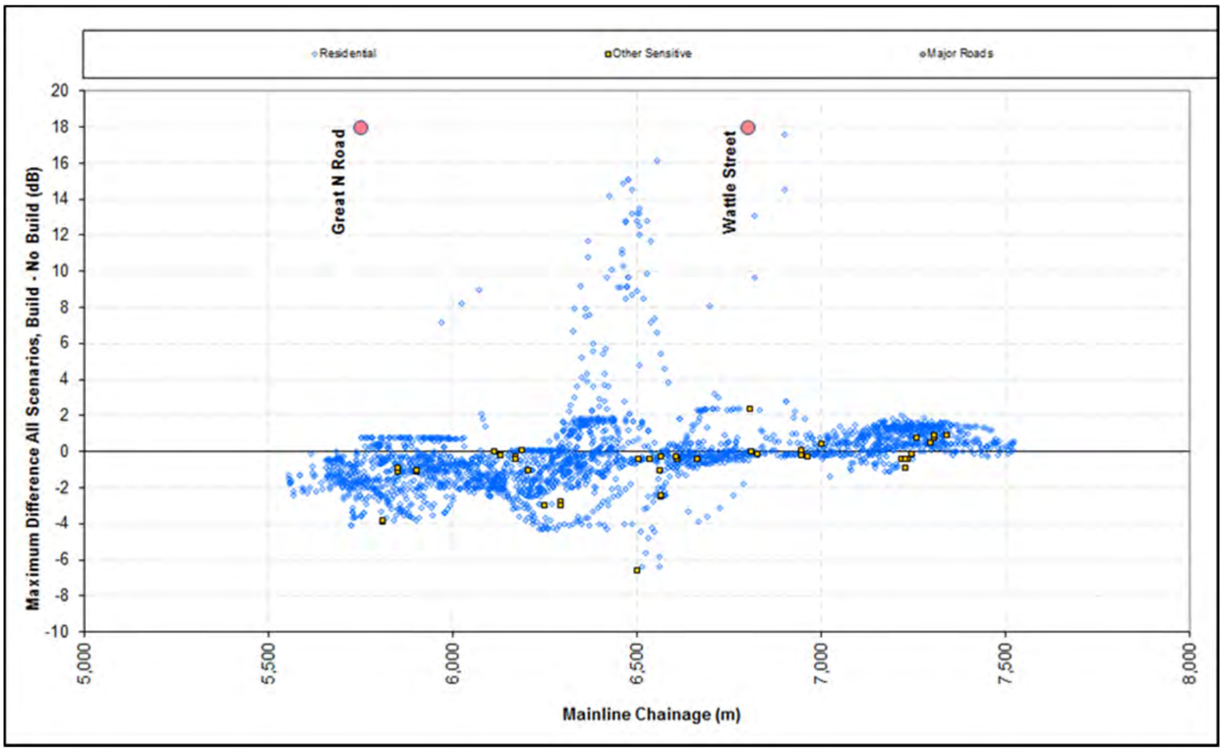


**Figure 5.2** **Predicted change in noise levels (Build minus No Build) without mitigation – Revised Design**




The information presented above indicates the following:

- The revised design is predicted to result in a marginally lower increase in noise for receivers near chainage 6,500. This location is adjacent to where the main design changes are proposed and is mainly due to the reconfiguration of the access ramps at Wattle Street.
- For the revised design, the change in noise levels for the remaining receivers is comparable to the EIS. This is due to no major design changes occurring in these locations.

### 5.1.2 Receivers considered for additional noise mitigation

Maps showing the location of receivers identified for consideration of additional noise mitigation (all assessment scenarios) are presented in **Appendix C.**

Further discussion of the project noise impacts (without mitigation) are presented in **Table 5.1**.

As per the EIS, this assessment counts each floor of properties as individual 'receivers'. Note that where multi-level residential buildings are apparent, counts for consideration of at-property treatment include the ground and first floor levels only. This is consistent with advice received from Roads and Maritime as it is generally not feasible and reasonable to provide at-receiver noise mitigation to multi-level residential receivers. Noise levels are assessed and outcomes referred to detailed design.

**Table 5.1 Receivers considered for additional noise mitigation by NCA**

| NCA | Receiver Type | Receiver floors (receiver lots) | EIS Receiver floors (receiver lots) | Comments |
|---|---|---|---|---|
| NCA13 | Residential | 0 (0) | 0 (0) | No change from EIS assessment |
| | Other | 4 (2) | 4 (2) | |
| NCA14 | Residential | 16 (14) | 16 (14) | No change from EIS assessment |
| | Other | 1 (1) | 1 (1) | |
| NCA15 | Residential | 28 (26) | 28 (26) | No change from EIS assessment |
| | Other | 0 (0) | 0 (0) | |
| NCA16 | Residential | 13 (11) | 15 (13) | Minor reduction in residential triggers compared to the EIS due to overall slight noise level decrease likely due to moving the WB entry ramp further from these receivers than the EIS design and provides benefit due to noise shielding from the dive structure. |
| | Other | 2 (2) | 2 (2) | |
| NCA17 | Residential | 31 (26) | 32 (27) | Minor reduction in residential triggers compared to the EIS due to moving the reconfigured WB Wattle Street further from receivers. Although the revised configuration of the WB entry ramp is moved to the outside (ie closer to receivers than the EIS design) it provides benefit due to noise shielding from the dive structure. |
| | Other | 0 (0) | 0 (0) | |
| NCA18 | Residential | 12 (9) | 13 (10) | Minor reduction in residential triggers compared to the EIS due to moving the reconfigured WB Wattle Street further from receivers. Although the revised configuration of the WB entry ramp is moved to the outside (ie closer to receivers than the EIS design) it is within a dive structure and so provides benefit due to noise shielding from the cutting. |
| | Other | 0 (0) | 0 (0) | |
| TOTAL | Residential | 100 (86) | 104 (90) | Minor reduction (four) in residential triggers and no change in Other Sensitive triggers compared to the EIS |
| | Other | 7 (5) | 7 (5) | |

## 5.2 Additional noise mitigation – low noise pavement

Low noise pavement is not considered reasonable on Wattle Street as the traffic speeds are relatively low and interrupted (traffic lights).

Receivers eligible for consideration of further additional noise mitigation are identified in **Appendix D**.

## 5.3 Additional noise mitigation – noise barriers

The noise barrier optimisation process is based on guidance in the NMG as discussed in **section 3**. The optimisation results are detailed in **Appendix E** with the assessed barriers identified in **Figure 5.3** and recommendations summarised in **Table 5.2**.

The revised design at Wattle Street interchange and creating of a cul-de-sac on Martin Street allows a noise barrier NW_WATTLE_01C to form a continuous section with the adjacent NW_WATTLE_01B barrier, whereas the EIS design required a break in this barrier and was considered unlikely to be built.

Noise barrier NW_WATTLE_01G has been found to be optimum at 5.5 metres (0.5 metres higher than the EIS).

The remaining barrier sections are generally consistent with the EIS, noting that the footprint of the barriers follow the revised design and this therefore results in minor variations in the total barrier lengths and therefore areas.

While the assessment has identified these potential barriers as additional noise mitigation, the recommended barriers are subject to further considerations during detailed design such as construction limitations, overshadowing, urban design and community preference.

Installation of the proposed noise barriers is predicted to reduce noise levels such that 25 receivers (total number of individual floors) no longer require consideration of further additional noise mitigation (at-property treatment).

**Figure 5.3 Noise barriers in the study area**

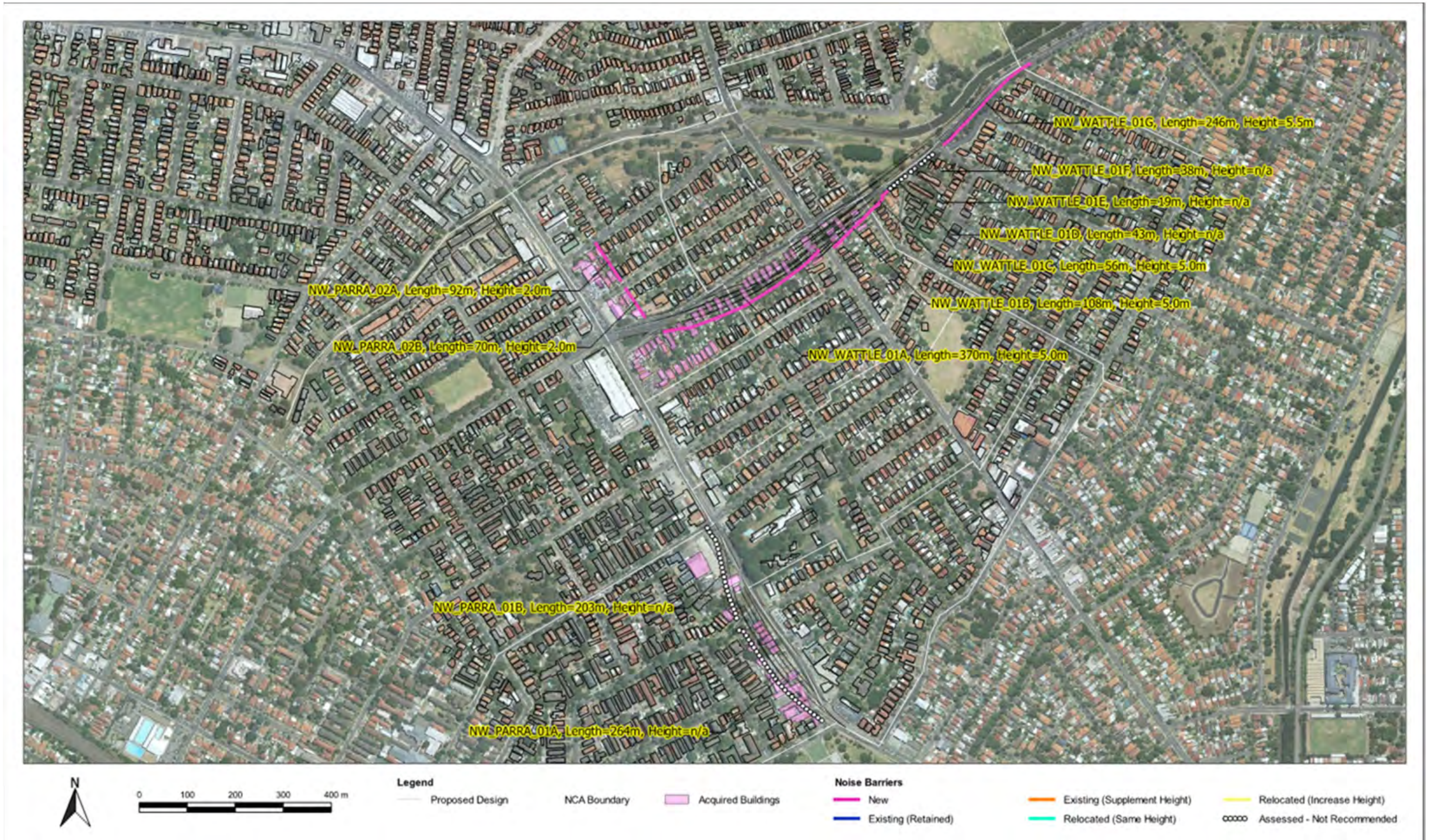


**Table 5.2 Noise barriers in the study area**

| Barrier Reference | Existing Barrier Height[1] (m) | Noise Barrier Details[2] | | | EIS Noise Barrier Details | | | Comments on Revised Design of Barriers |
|---|---|---|---|---|---|---|---|---|
| | | Type | Length (m) | Height (m) | Type | Length (m) | Height (m) | |
| NW_WATTLE_01A | - | New | 370 | 5.0 | New | 374 | 5.0 | Maximum design height 8.0 m, initial height of 5.0 m and Optimised design height of 5.5 m. Benefiting receivers achieve a mixture of 2 and 5 dBA IL. The optimised design height does not provide 10 dB insertion loss. The initial design height reduces triggers to 2/3 of those that can be eliminated between 0 m and the maximum height barrier. Therefore, recommend barrier height of 5.0 m |
| NW_WATTLE_01B | - | New | 108 | 5.0 | New | 94 | 5.0 | Maximum design height is 8.0 m. Initial design height is 7.0 m and the Optimised height is 7.5 m. The Optimised design height has benefiting receivers with a mixture of 2,5 and 10 dBA IL. However, based on further feasible and reasonable considerations the barrier sections NW_WATTLE_01D to NW_WATTLE_01E (short sections broken by driveway access) are unlikely to be built due to overshadowing and visual impacts. Therefore, recommend at property treatments for the triggered receivers instead of a barrier. To be further considered during detailed design. NW_WATTLE_01B is continuous with NW_WATTLE_01C and a barrier height of 5.0 m for these barriers is recommended due to proximity of adjacent barriers and community perception of inequitable outcomes compared to neighbouring dwellings where screening has been reduced due to acquisition of properties and subsequent demolition. |
| NW_WATTLE_01C | - | New | 56 | 5.0 | New not reasonable | 51 | n/a | |
| NW_WATTLE_01D | - | New not reasonable | 43 | n/a | New not reasonable | 43 | n/a | |
| NW_WATTLE_01E | - | New not reasonable | 19 | n/a | New not reasonable | 19 | n/a | |
| NW_WATTLE_01F | - | New not reasonable | 38 | n/a | New not reasonable | 37 | n/a | |

| Barrier Reference | Existing Barrier Height[1] (m) | Noise Barrier Details[2] Type | Length (m) | Height (m) | EIS Noise Barrier Details Type | Length (m) | Height (m) | Comments on Revised Design of Barriers |
|---|---|---|---|---|---|---|---|---|
| NW_WATTLE_01G | - | New | 246 | 5.5 | New | 246 | 5.0 | Maximum design height is 6.0 m (due to noise levels at triggered receivers being limited by flanking around the side of the noise barrier). Initial design height is 5.0 m and Optimised height is 5.5 m. The Optimised design height has benefiting receivers with a mixture of 2, 5 and 10 dBA IL.<br>The maximum height barrier is unlikely to be within 125% of the cost of the Optimised design height and it does not provide more than a 2 dBA IL benefit compared to the Optimised design height. Therefore, recommend barrier height of 5.5 m. Note: barrier extends slightly past the limit of works but only to the next logical boundary. |

Note 1: Existing height is the height of the existing or the replaced existing noise barrier (ie maintaining the same top of noise barrier height as the existing barrier)

Note 2: Recommended height is subject to further considerations during detailed design such as construction limitations, overshadowing, urban design and community preference.

## 5.4 Operational noise impacts with mitigation

Predicted noise level maps showing noise levels at all residential receiver buildings for the Build (with mitigation) scenarios are provided in **Appendix F**.

The 'without mitigation' noise predictions are used to identify receivers which qualify for consideration of at-property treatment.

### 5.4.1 Receivers considered for at-property treatment

With reference to the criteria for additional mitigation (refer to **Section 3**), the number of receivers which have been identified as eligible for consideration of property treatments after additional noise mitigation (noise barriers) are shown in **Table 5.3**.

**Table 5.3 Receivers considered eligible for at-property treatment**

| NCA | Receiver Type | 2021 Final Build | | | 2031 Final Build | | | TOTAL | | EIS Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Night | Combined | Day | Night | Combined | By Floor | By Lot | By Floor | By Lot |
| NCA13 | Residential | - | - | - | - | - | - | - | - | - | - |
| | Other | 3 | - | 3 | 4 | - | 4 | 4 | 2 | 4 | 2 |
| NCA14 | Residential | 6 | 6 | 6 | 6 | 9 | 9 | 9 | 8 | 9 | 8 |
| | Other | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| NCA15 | Residential | 16 | 20 | 20 | 16 | 20 | 20 | 20 | 18 | 18 | 16 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| NCA16 | Residential | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 11 | 15 | 13 |
| | Other | 2 | - | 2 | 1 | - | 1 | 2 | 2 | 2 | 2 |
| NCA17 | Residential | 17 | 22 | 22 | 16 | 19 | 19 | 22 | 19 | 25 | 20 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| NCA18 | Residential | 5 | 6 | 6 | 4 | 7 | 7 | 7 | 5 | 8 | 6 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| TOTAL | | | | | | | | 78 | 66 | 82 | 68 |

The information presented in **Table 5.3** indicates that the revised Wattle Street interchange design, in conjunction with the recommended additional noise mitigation, results in a minor reduction in the total number of at-property treatments for the project (four receivers fewer than the EIS). This is due to the following:

- Noise barrier NW_WATTLE_01G is recommended at 5.5 metres which is 0.5 metres higher than recommended in the EIS and reduces noise levels in the Build (with mitigation) case compared to the EIS
- Noise levels on the north west side of Wattle street are slightly lower than the EIS design due to the WB entry ramp moving further from these receivers than the EIS design
- Slightly better shielding effect from the embankment and dive structure to the south east side of Wattle Street with the revised design.

The locations of the receivers eligible for consideration of property treatment are shown in the maps in **Appendix G**. These receivers correspond to those eligible for consideration of additional noise mitigation where the feasible and reasonable mitigation does not reduce the noise levels to meet the NCG controlling criterion.

## 5.5 Discussion of at-property treatments

For individual residential receivers Roads and Maritime does not consider it reasonable to consider noise mitigation above the ground and first floor.

Refer to **Section 7.4** and **Section 7.5** in the noise and vibration technical paper for discussion of applicable at-property treatments for these groups, noting that the finalised requirement for treatment would be confirmed during detailed design, following property inspections as required.

## 5.6 Maximum noise levels

Indicative increases in maximum noise levels were evaluated based on an elevated source height corresponding to the height of a truck exhaust.

Evaluation of the potential increase in maximum noise levels indicates that maximum noise level events may increase at residential receivers in the following locations:

- NCA13 – Receivers west of Parramatta Road across from Wattle Street. Increases of up to 1 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project (refer to **Section 5.5.1**)
- NCA14 – Receivers east of Parramatta Road adjacent to Wattle Street. Increases of up to 2 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project
- NCA15 – Receivers either side of Wattle Street adjacent to the new tunnel portals. Increases of up to 2 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project
- NCA16 – Receivers to the north of Wattle Street adjacent to Ramsay Street. Increases of up to 3 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project
- NCA17 – Receivers to the south of Wattle Street, north of Martin Street. Increases of up to 2 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project
- NCA18 – Receivers to the south of Wattle Street adjacent to Ramsay Street. Increases of up to 14 dBA are predicted. It is noted that some receivers are eligible for consideration of at property treatments in this catchment as part of the project.

**Table 5.4 Comparison of EIS LAmax noise levels to this assessment**

| NCA | EIS $L_{Amax}$ Assessment | This $L_{Amax}$ Assessment |
|---|---|---|
| NCA13 | Increases of up to 1 dBA | Increases of up to 1 dBA |
| NCA14 | Increases of up to 2 dBA | Increases of up to 2 dBA |
| NCA15 | Increases of up to 2 dBA | Increases of up to 2 dBA |
| NCA16 | Increases of up to 3 dBA | Increases of up to 3 dBA |
| NCA17 | Increases of up to 5 dBA | Increases of up to 2 dBA |
| NCA18 | Increases of up to 16 dBA | Increases of up to 14 dBA |

Compared to the EIS $L_{Amax}$ assessment the magnitude of maximum noise level events has decreased in NCA17 and NCA18 due to changes in the locations of noise barriers in these areas. The magnitude of maximum noise level events has not changed in NCA13, NCA14, NCA15 and NCA16.

The proposed noise barrier designs (refer to **Section 5.4**) are predicted to reduce the noise level of maximum noise level events for receivers which benefit from new or increased height barriers with no change to the field of view to the road. These benefits are mainly in receiver areas to the south of Wattle Street in NCA14, NCA15, NCA17 and NCA18.

Some receivers as identified in the points above may experience an increase in magnitude of maximum noise events due to changes in view to the road alignment. The noise barrier optimisation process (refer to **Section 5.4**) does not account for changes in magnitude of the $L_{AFmax}$ noise events. It is therefore recommended that detailed investigation of maximum noise levels due to the project should be undertaken during detailed design including consideration of feasible and reasonable noise mitigation on the basis of maximum noise levels.

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# 6 Conclusion

In relation to noise impacts, the proposed design changes at the Wattle Street interchange have been found to vary from the EIS assessment as follows:

- The revised alignment moves the WB entry ramp closer to receivers to the south east of Wattle Street (NCA17 and NCA18); however, the dive structure provides noise screening benefit which reduces the noise impact of this change. The WB Wattle street connection moves to the south (nearer receivers); however, the combined effect of these changes is a marginal reduction in noise levels compared to the EIS design
- The predicted change in noise impacts compared to the EIS design west of Ramsay Street was found to be negligible.

The assessment of operational noise impacts was undertaken using the methodology adopted in the EIS. Modelling input differences between this assessment and the EIS are limited to the alignment of the revised design.

Differences between the predicted noise impacts for the revised design and that assessed in the EIS result in the follows changes to the proposed noise mitigation:

- Overall minor reduction in receivers eligible for consideration of additional noise mitigation for the revised design by four (4) receivers
- Noise barrier NW_WATTLE_01C can be continuous with the adjacent barrier due to the revised design creating a cul-de-sac at Martin Street. Previously the EIS design required access gaps in the barriers which deemed this section unlikely to be built
- Noise barrier NW_WATTLE_01G is recommended at 5.5 metre height (previously 5.0 metres)
- Minor change in overall number of receivers eligibly for consideration of at-property treatments (reduction of four receivers compared to the EIS assessment)
- Lower maximum noise levels by approximately 2 dB to 3 dB compared to the EIS assessment at the most affected receivers in NCA17 and NCA18 due to changes in the locations of noise barriers in these areas with the revised design
- Maximum noise levels at the most affected receivers in NCA13, NCA14, NCA15 and NCA16 are similar to the EIS assessment.

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# WESTCONNEX M4 EAST
# CONSTRUCTION NOISE IMPACT ASSESSMENT
# AUSGRID SITE COMPOUND

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# 1 Introduction

## 1.1 Background

Noise and vibration impacts during construction of the M4 East project have been assessed and are reported in the noise and vibration technical paper (SLR report reference 610.13569-R2 dated 4 September 2015), included as part of the project's Environmental Impact Statement (EIS).

The EIS assessment included establishment and operation of the Homebush Bay Drive civil site, the extents of which are indicated in **Figure 1.1**.


**Figure 1.1 Indicative EIS layout - Homebush Bay Drive civil site**

It is proposed to make temporary use of the Ausgrid land to the north of the Homebush Bay Drive interchange as a site compound for car parking purposes associated with the Homebush Bay Drive civil site is currently being considered. This change in construction footprint is considered to require additional assessment as it may influence predicted noise impacts at the surrounding noise-sensitive receivers.

The proposed temporary Ausgrid site configuration is shown in **Figure 1.2**.

## 1.2 Scope of this report

SLR has been engaged by Sydney Motorway Corporation (SMC) to assess potential noise impacts from the use of the Ausgrid land (car park) to the north of the Homebush Bay Drive interchange as a site compound.

This report should be read in conjunction with the EIS noise and vibration technical paper.

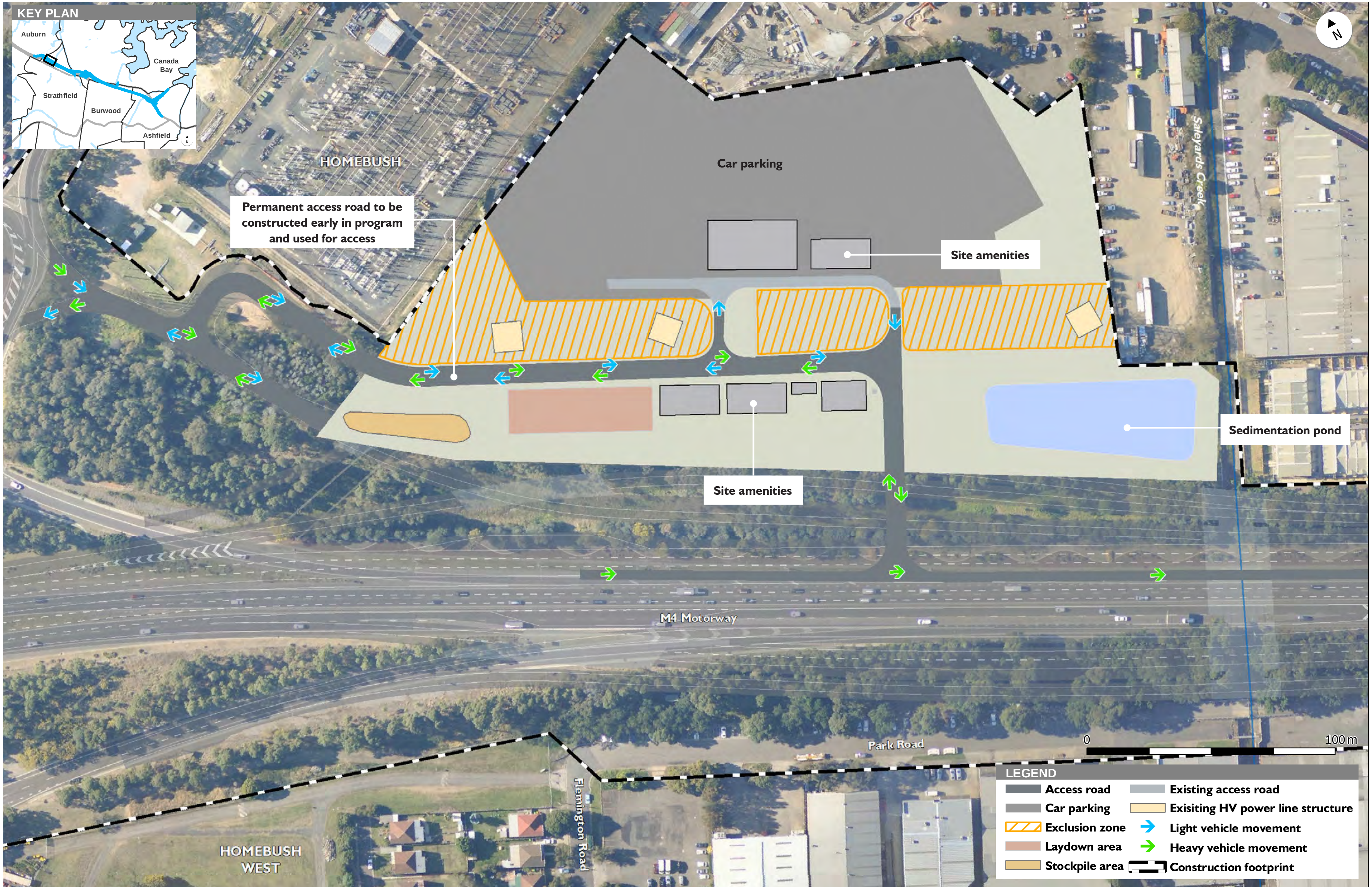


Figure 1.2 Revised Homebush Bay Drive civil site (C1)

## 1.3 Guidelines

Consistent with the EIS noise and vibration technical paper the following guidelines have been used for this assessment:

- Construction noise has been assessed in accordance with the Interim Construction Noise Guideline (ICNG) ((NSW) Department of Environment and Climate Change (DECC), 2009)
- Construction road traffic noise has been assessed taking guidance from the noise assessment procedure contained in the NSW Road Noise Policy (RNP) ((NSW) Environment Protection Agency (EPA), 2011)

## 1.4 Terminology

The assessment has used specific acoustic terminology throughout. An explanation of common terms is included as **Appendix A** for reference.

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# 2 Proposed construction activities

## 2.1 Site location

The site is surrounded by the Ausgrid switching yard and the M4 motorway beyond to the south and west, residential and commercial receivers to the east and commercial receivers to the north. The noise catchment areas (NCAs) and receiver types are shown in **Figure 2.1**.


**Figure 2.1** **NCAs and surrounding receiver types**

## 2.2 Proposed works

The additional land (Ausgrid site) is proposed to be used solely for construction workforce parking and site amenities. No construction activities (including stockpiling and laydown) are proposed for this area.

The Ausgrid site will be accessed by light vehicles only. Light vehicle access will be obtained via a vehicle access road that connects the sites southern boundary with Homebush Bay Drive on the western side of the site, and from the M4 to the south.

## 2.3 Construction hours

The site is proposed to mostly operate only during the standard working hours of between:

- 7.00 am and 6.00 pm Monday to Friday
- 8.00 am and 1.00 pm on Saturdays.

There would, however, be instances when the facilities would be used to support out of hours works, eg during traffic switches on the M4, pavement works on M4, for oversized plant deliveries.

## 2.4 Noise management levels

Consistent with the EIS noise and vibration technical paper, the noise management levels (NMLs) used for the assessment are summarised in **Table 2.1**.

**Table 2.1 NMLs for construction**

| NCA | Logger ID | Receiver Type | RBL | | | Standard Construction (RBL+10dB) | Out of Hours (RBL+5dBA) | | | Sleep Disturbance Screening (RBL+15) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Eve | Night | Daytime Period | Daytime Period | Evening Period | Night-time Period | |
| NCA01 | L23 | Residential | 53 | 53 | 49 | 63 | 58 | 58 | 54 | 64 |
| NCA02 | L01 | Residential | 53 | 52 | 46 | 63 | 58 | 57 | 51 | 61 |
| NCA03 | L02 | Residential | 50 | 50 | 46 | 60 | 55 | 55 | 51 | 61 |
| NCA04 | L03 | Residential | 50 | 49 | 43 | 60 | 55 | 54 | 48 | 58 |
| NCA05 | L04 | Residential | 56 | 56 | 48 | 66 | 61 | 61 | 53 | 63 |
| ALL | - | Commercial | n/a | | | 70 - when in use | | | | n/a |
| ALL | - | Place of Worship | n/a | | | Internal noise level 45 dBA[1] - when in use | | | | n/a |

Note 1: For the purpose of this assessment, it is conservatively assumed that all schools and places of worship have openable windows. On the basis that external noise levels are typically 10 dBA higher than internal noise levels when windows are open, an external NML of 55 dBA LAeq(15minute) has been adopted.

## 2.5 Construction Equipment

Sound power levels for the typical operation of construction equipment applied in the modelling are listed in **Table 2.2**. These noise levels have been taken from verified test data and global standards that form part of the SLR noise database. The assessed scenarios include installation of perimeter fencing, installation of site buildings and use of existing carparking area during construction.

**Table 2.2 Sound power levels for construction equipment**

| Scenario Name | Activity (ie Equipment Split) | Equipment (realistic worst-case) | Worst-case items in same location | Sound Power Level (dBA)[1] LWA Item | LWA Activity | LWAmax Activity | Estimated duration of works at any one locality[2] |
|---|---|---|---|---|---|---|---|
| Construction compound - Ausgrid site establishment | Installation of temporary perimeter fencing | Low Bed/Float | 1 | 100 | 114 | 116 | 15.0 |
| | | Hand Tools | 1 | 94 | | | 15.0 |
| | | Truck (HIAB) | 1 | 105 | | | 15.0 |
| | | Back Hoe (7.5 tonne JCB) | 1 | 102 | | | 15.0 |
| | | Auger Drill Rig | 1 | 111 | | | 15.0 |
| | | Concrete Truck / Agitator | 1 | 106 | | | 15.0 |
| | | Hand Tools (electric) | 2 | 96 | | | 15.0 |

| Scenario Name | Activity (ie Equipment Split) | Equipment (realistic worst-case) | Worst-case items in same location | Sound Power Level (dBA)[1] | | | Estimated duration of works at any one locality[2] |
|---|---|---|---|---|---|---|---|
| | | | | $L_{WA}$ Item | $L_{WA}$ Activity | $L_{WAmax}$ Activity | |
| Construction compound - Ausgrid site establishment | Installation of site buildings (office and amenities) | Truck (10 tonne) | 2 | 103 | 111 | 113 | 15.0 |
| | | Hand Tools | 2 | 94 | | | 15.0 |
| | | Franna Crane | 1 | 99 | | | 15.0 |
| | | Telehandler | 1 | 92 | | | 15.0 |
| | | Semi Trailer | 1 | 106 | | | 15.0 |
| | | Mobile Crane (50 tonne) | 1 | 100 | | | 15.0 |
| | | Hand Tools (electric) | 2 | 96 | | | 15.0 |
| | Car parking | Car Parking | 50 | 73 | 78 | 81 | 1.0 |

Note 1: In accordance with the EPA ICNG for activities identified as particularly annoying (such as jackhammering, rock breaking and power saw operation), a 5 dBA 'penalty' is added to predicted noise levels when using the quantitative method.

Note 2: Limited information is available on activity durations adjacent to individual sensitive receivers at this phase of the project, and hence, the key activities have only high level assumptions made with respect to proposed duration. These durations do not represent the overall activity duration.

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# 3 Noise assessment at the nearest noise sensitive receivers

## 3.1 Predicted noise levels

In order to show the extent of impacts surrounding the site, maps showing NML exceedances at all nearby sensitive receivers as well as noise contours are presented in **Appendix B**.

These predicted NML exceedances are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in proximity to adjacent receivers.

**Table 3.1** and **Table 3.2** present a summary of the worst-case predicted noise impacts and median predicted noise impacts respectively.

**Table 3.1 Worst-affected daytime NML exceedances - Ausgrid compound**

| Scenario | NCA | Receiver Type | RBL | NML | Noise Level - $L_{Aeq(15minute)}$ (dBA) | |
|---|---|---|---|---|---|---|
| | | | | | Worst-case Predicted at Nearby Receivers[1] | NML Exceedance[2] |
| Installation of temporary perimeter fencing | NCA01.COM | Commercial | n/a | 70 | 69 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | 51 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | 50 | - |
| | NCA01.RES | Residential | 53 | 63 | 65 | 2 |
| | NCA02.COM | Commercial | n/a | 70 | 49 | - |
| | NCA02.RES | Residential | 53 | 63 | 58 | - |
| | NCA03.COM | Commercial | n/a | 70 | 46 | - |
| | NCA03.RES | Residential | 50 | 60 | 52 | - |
| | NCA04.RES | Residential | 50 | 60 | 36 | - |
| Installation of site buildings (office and amenities) | NCA01.COM | Commercial | n/a | 70 | 56 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | 48 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | 44 | - |
| | NCA01.RES | Residential | 53 | 63 | 53 | - |
| | NCA02.COM | Commercial | n/a | 70 | 44 | - |
| | NCA02.RES | Residential | 53 | 63 | 50 | - |
| | NCA03.COM | Commercial | n/a | 70 | 41 | - |
| | NCA03.RES | Residential | 50 | 60 | 46 | - |
| | NCA04.RES | Residential | 50 | 60 | 31 | - |
| Car parking | NCA01.COM | Commercial | n/a | 70 | 31 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | <30 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | <30 | - |
| | NCA01.RES | Residential | 53 | 63 | <30 | - |
| | NCA02.COM | Commercial | n/a | 70 | <30 | - |
| | NCA02.RES | Residential | 53 | 63 | <30 | - |
| | NCA03.COM | Commercial | n/a | 70 | <30 | - |
| | NCA03.RES | Residential | 50 | 60 | <30 | - |
| | NCA04.RES | Residential | 50 | 60 | <30 | - |

Note 1: Worst-case predicted noise levels presented in red text indicate presence of highly noise affected receivers as described by the ICNG.

Note 2: Results are representative of the worst-affected receiver. Typically no impacts are predicted at the outer extents of the NCAs. Full extent of noise impacts at all adjacent receivers are shown in **Appendix B**.

**Table 3.2 Median daytime NML exceedances - Ausgrid compound**

| Scenario | NCA | Receiver Type | RBL | NML | Median Noise Level - $L_{Aeq(15minute)}$ (dBA) | |
|---|---|---|---|---|---|---|
| | | | | | Worst-case Predicted at Nearby Receivers[1] | NML Exceedance[2] |
| Installation of temporary perimeter fencing | NCA01.COM | Commercial | n/a | 70 | 48 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | 50 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | 45 | - |
| | NCA01.RES | Residential | 53 | 63 | 54 | - |
| | NCA02.COM | Commercial | n/a | 70 | 44 | - |
| | NCA02.RES | Residential | 53 | 63 | 42 | - |
| | NCA03.COM | Commercial | n/a | 70 | 31 | - |
| | NCA03.RES | Residential | 50 | 60 | 34 | - |
| | NCA04.RES | Residential | 50 | 60 | <30 | - |
| Installation of site buildings (office and amenities) | NCA01.COM | Commercial | n/a | 70 | 48 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | 50 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | 45 | - |
| | NCA01.RES | Residential | 53 | 63 | 54 | - |
| | NCA02.COM | Commercial | n/a | 70 | 44 | - |
| | NCA02.RES | Residential | 53 | 63 | 42 | - |
| | NCA03.COM | Commercial | n/a | 70 | 31 | - |
| | NCA03.RES | Residential | 50 | 60 | 34 | - |
| | NCA04.RES | Residential | 50 | 60 | <30 | - |
| Car parking | NCA01.COM | Commercial | n/a | 70 | <30 | - |
| | NCA01.OHO | Other (Hotel) | n/a | 60 | <30 | - |
| | NCA01.OOA | Other (Outdoor Active) | n/a | 65 | <30 | - |
| | NCA01.RES | Residential | 53 | 63 | <30 | - |
| | NCA02.COM | Commercial | n/a | 70 | <30 | - |
| | NCA02.RES | Residential | 53 | 63 | <30 | - |
| | NCA03.COM | Commercial | n/a | 70 | <30 | - |
| | NCA03.RES | Residential | 50 | 60 | <30 | - |
| | NCA04.RES | Residential | 50 | 60 | <30 | - |

Note 1: Worst-case predicted noise levels presented in red text indicate presence of highly noise affected receivers as described by the ICNG.

Note 2: Results are representative of the worst-affected receiver. Typically no impacts are predicted at the outer extents of the NCAs. Full extent of noise impacts at all adjacent receivers are shown in **Appendix B**.

## 3.2 Worst-affected receiver impacts

The results presented in **Table 3.1** indicate it is unlikely that the Ausgrid works will result in any significant NML exceedances at nearby receivers. Minor NML exceedances of up to 2 dB are predicted at the most potentially affected residential receivers in NCA01.RES to the east of the site. This minor exceedance of the NMLs is predicted to occur during the 'Installation of temporary perimeter fencing' scenario and, as such, is not practicable to mitigate using hoarding. The minor NML exceedances resulting from this construction scenario would only be apparent for a short period of time while the fencing is being erected immediately adjacent the most potentially affected receivers and it is noted that the existing fence would be retained in some locations (to be confirmed during construction planning). A total of two residential receivers are predicted to have NML exceedances.

As the predicted noise from the carparking activity is relatively low at the surrounding receivers, out of hours (OOH) use of the site for carparking would not be anticipated to exceed the respective OOH NMLs (refer to **section 2.4**).

## 3.3 Typical receiver impacts

The results presented in **Table 3.2** indicate the Ausgrid works will not typically result in NML exceedances at the surrounding sensitive receivers with the median worst-case predicted levels significantly below the NMLs.

## 3.4 Other sensitive receiver impacts

NML exceedances are not predicted at any other sensitive receivers surrounding the proposed Ausgrid worksite.

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# 4 Conclusion

Noise predictions for the construction works associated with the Ausgrid site compound have been undertaken where appropriate. The predictions indicate that the proposed activities are unlikely to result in significant NML exceedances at surrounding sensitive receivers. Worst-case noise impacts during the construction scenarios, assessed as part of the EIS, indicate the requirements for consideration of mitigation as part of the construction noise and vibration management plan (CNVMP) during construction planning.

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# WESTCONNEX M4 EAST
# OPERATIONAL ROAD TRAFFIC NOISE IMPACT ASSESSMENT
# DESIGN CHANGE - HOMEBUSH BAY DRIVE INTERCHANGE

## Appendix A to G

Acoustic Terminology

## 1 Sound Level or Noise Level

The terms ‘sound’ and ‘noise’ are almost interchangeable, except that in common usage ‘noise’ is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or $L_P$ are commonly used to represent Sound Pressure Level. The symbol $L_A$ represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x $10^{-5}$ Pa.

## 2 ‘A’ Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an ‘A-weighting’ filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

| Sound Pressure Level (dBA) | Typical Source | Subjective Evaluation |
|---|---|---|
| 130 | Threshold of pain | Intolerable |
| 120 | Heavy rock concert | Extremely noisy |
| 110 | Grinding on steel | |
| 100 | Loud car horn at 3 m | Very noisy |
| 90 | Construction site with pneumatic hammering | |
| 80 | Kerbside of busy street | Loud |
| 70 | Loud radio or television | |
| 60 | Department store | Moderate to quiet |
| 50 | General Office | |
| 40 | Inside private office | Quiet to very quiet |
| 30 | Inside bedroom | |
| 20 | Recording studio | Almost silent |

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as ‘linear’, and the units are expressed as dB(lin) or dB.

## 3 Sound Power Level

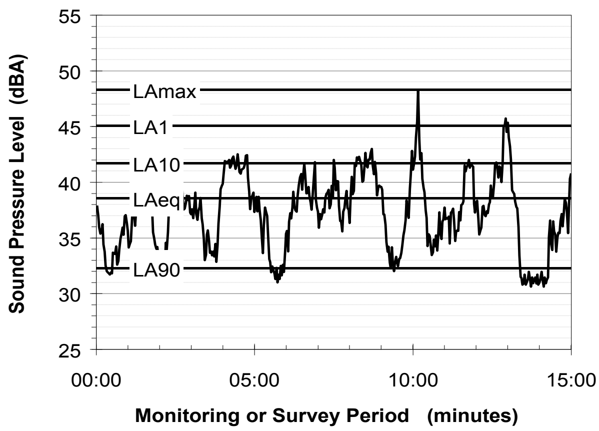
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or $L_W$, or by the reference unit $10^{-12}$ W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

## 4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels $L_{AN}$, where $L_{AN}$ is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the $L_{A1}$ is the noise level exceeded for 1% of the time, $L_{A10}$ the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.




Of particular relevance, are:

$L_{A1}$ The noise level exceeded for 1% of the 15 minute interval.

$L_{A10}$ The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

$L_{A90}$ The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

$L_{Aeq}$ The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the ‘repeatable minimum’ $L_{A90}$ noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or ‘average’ levels representative of the other descriptors ($L_{Aeq}$, $L_{A10}$, etc).

## 5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than ‘broad band’ noise.

## 6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

## 7 Frequency Analysis

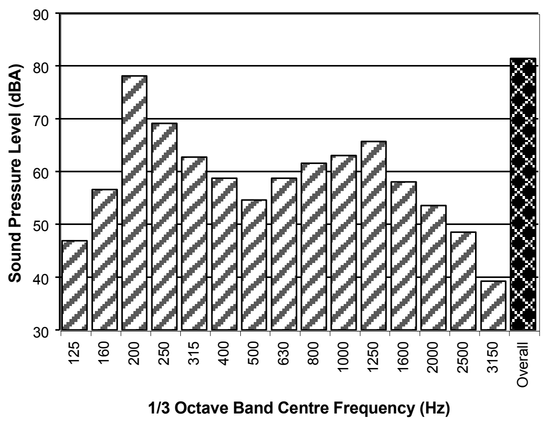
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.




## 8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log ($V/V_o$), where $V_o$ is the reference level ($10^{-9}$ m/s). Care is required in this regard, as other reference levels may be used by some organizations.

## 9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

## 10 Over-Pressure

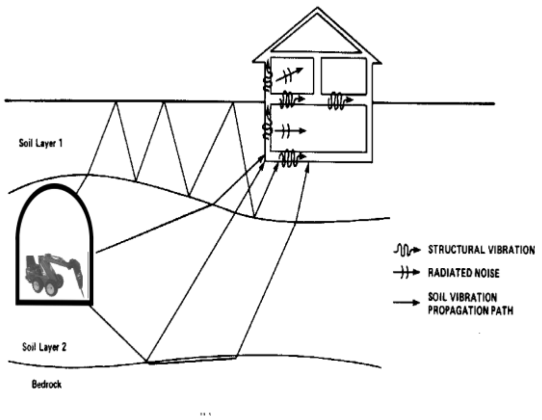
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

## 11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.




The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

# Appendix B

Report 610.13569-R4

Residential Noise Predictions - Build


Proposed Design
Receiver One Storey
Acquired Buildings
Receiver >One Storey
Noise Barrier

Predicted Noise Level (LAeq,15hour)

- <55 dB
- 55 - 57 dB
- >65 dB
- 57 - 59 dB
- 59 - 61 dB
- 61 - 63 dB
- 63 - 65 dB


SLR

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| | |
|---|---|
| Project No.: | 610.13569 |
| Date: | 6/11/2015 |
| Drawn by: | ALW |
| Scale: | 1:13,000 |
| Sheet Size: | @ A4 |
| Projection: | GDA 1994 MGA Zone 56 |

WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions**
**2021, Daytime**
**Build (Without Mitigation)**


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| Date: | 6/11/2015 |
| Drawn by: | ALW |
| Scale: | 1:13,000 |
| Sheet Size: | @ A4 |
| Projection: | GDA 1994 MGA Zone 56 |

Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
Receiver >One Storey

Predicted Noise Level (LAeq,9hour)

- <50 dB
- 50 - 52 dB
- >60 dB
- 52 - 54 dB
- 54 - 56 dB
- 56 - 58 dB
- 58 - 60 dB

WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions 2021, Night-time Build (Without Mitigation)**



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| | |
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Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
Receiver >One Storey

Predicted Noise Level (LAeq,15hour)

<55 dB
55 - 57 dB
>65 dB
57 - 59 dB
59 - 61 dB
61 - 63 dB
63 - 65 dB

WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions**
**2031, Daytime**
**Build (Without Mitigation)**


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N

0 100 200 300 400 m

Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
Receiver >One Storey

Predicted Noise Level (LAeq,9hour)

<50 dB
50 - 52 dB
>60 dB
52 - 54 dB
54 - 56 dB
56 - 58 dB
58 - 60 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions**
**2031, Night-time**
**Build (Without Mitigation)**

# Appendix C

Report 610.13569-R4

Additional noise mitigation locations

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0 100 200 300 400 m

Proposed Design

Acquired Buildings

Noise Barriers

**Triggered Receivers**

>2.0 dB Increase

Cumulative Limit

Both

Residential

Other Sensitive

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**Receivers Considered for Additional Noise Mitigation Build (Without Additional Mitigation)**

# Appendix D

Report 610.13569-R4

Receivers considered for noise barriers


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**Receivers Considered for Noise Barriers (Low Noise Pavement Included)**

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# Appendix E

Report 610.13569-R4

Noise barrier optimisation analysis

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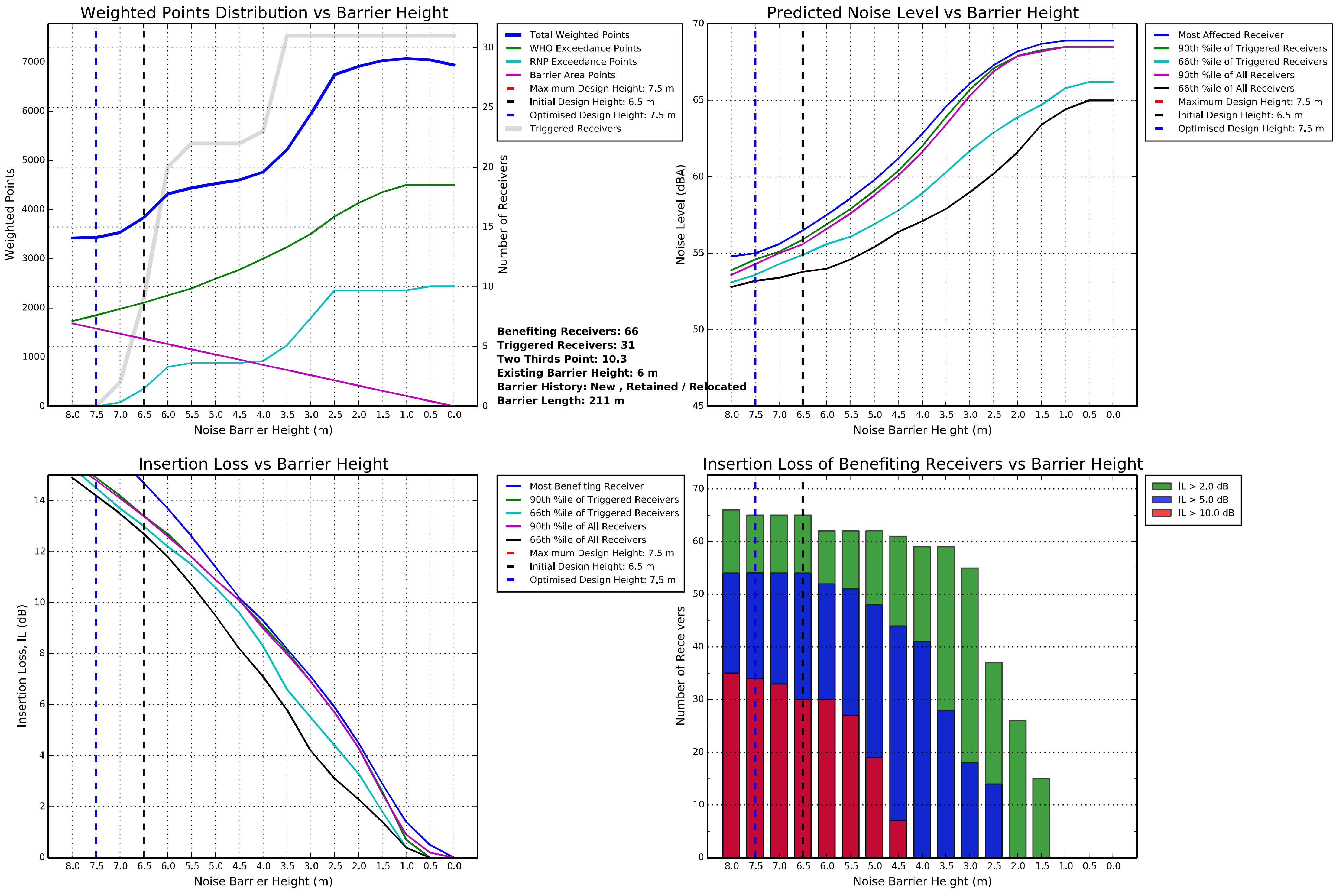
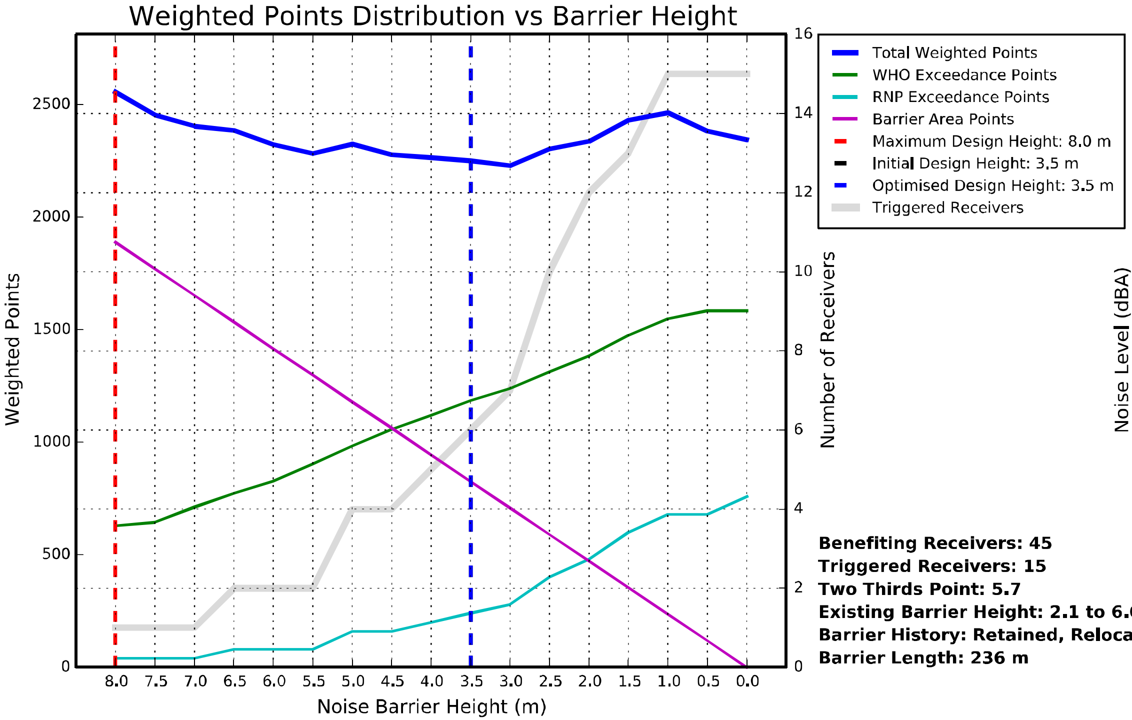
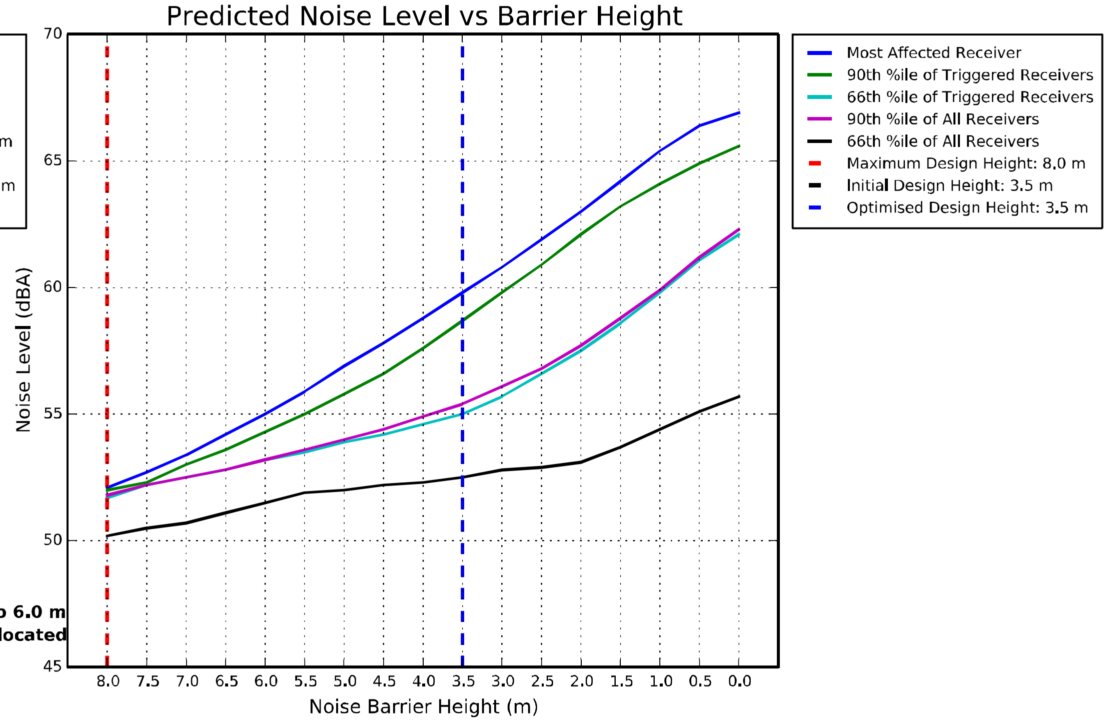
# Noise Barrier Optimisation: NW_M4EB_01A-B

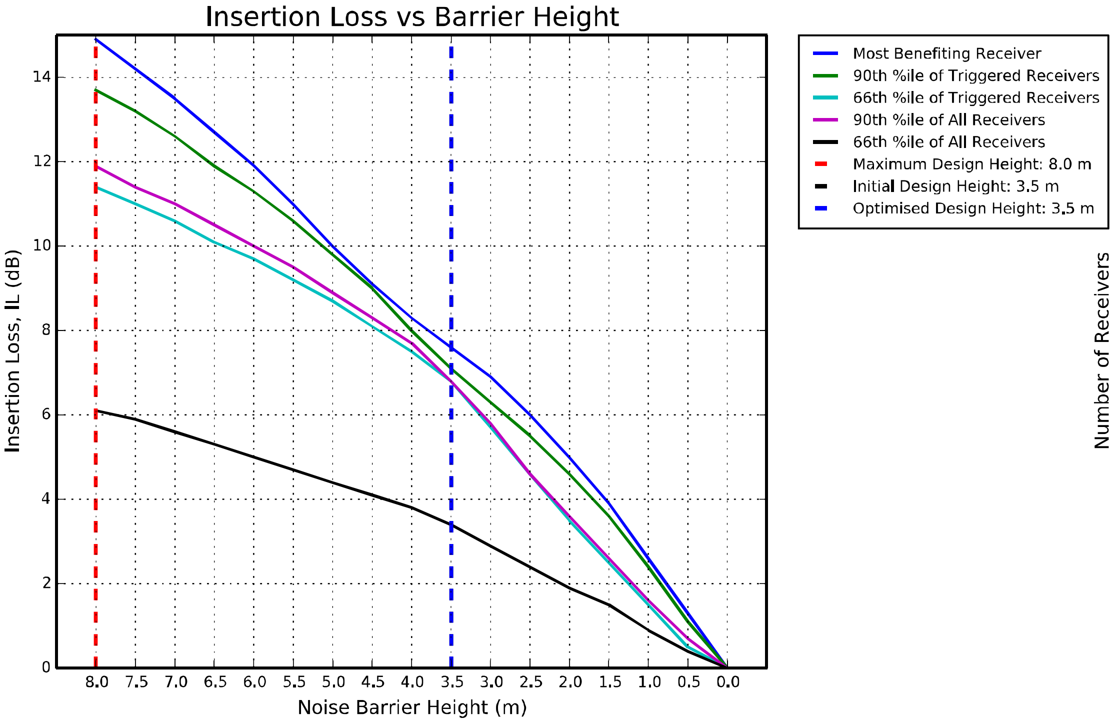


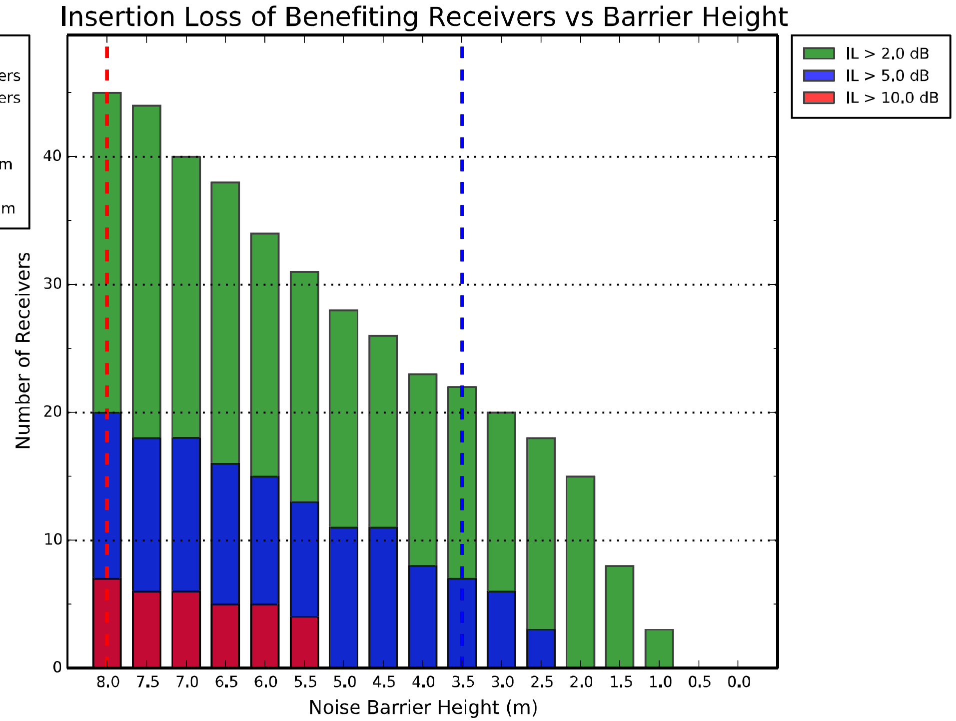
# Noise Barrier Optimisation: NW_M4EB_01C-E



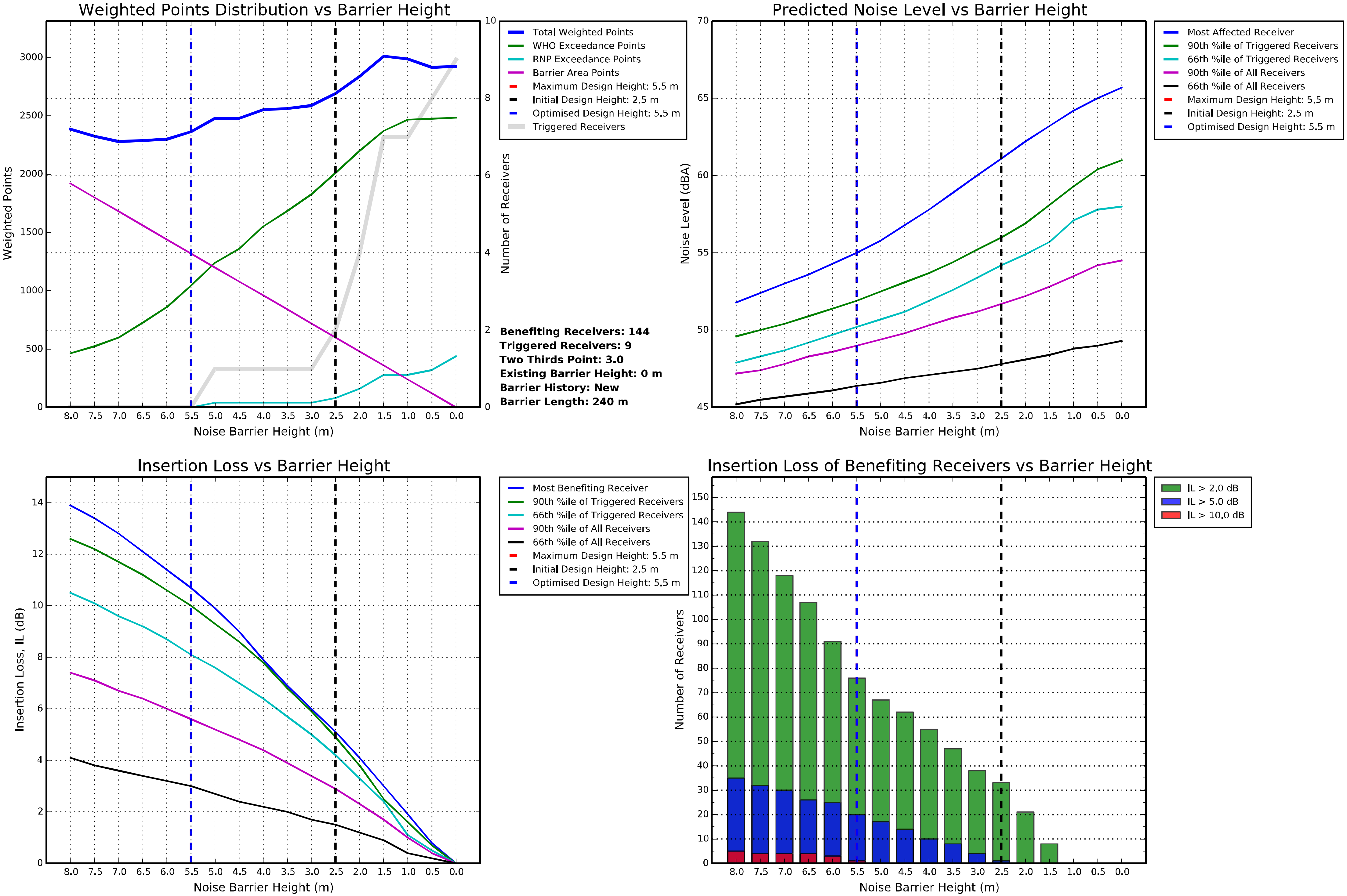

**Benefiting Receivers: 45**
**Triggered Receivers: 15**
**Two Thirds Point: 5.7**
**Existing Barrier Height: 2.1 to 6.0 m**
**Barrier History: Retained, Relocated**
**Barrier Length: 236 m**



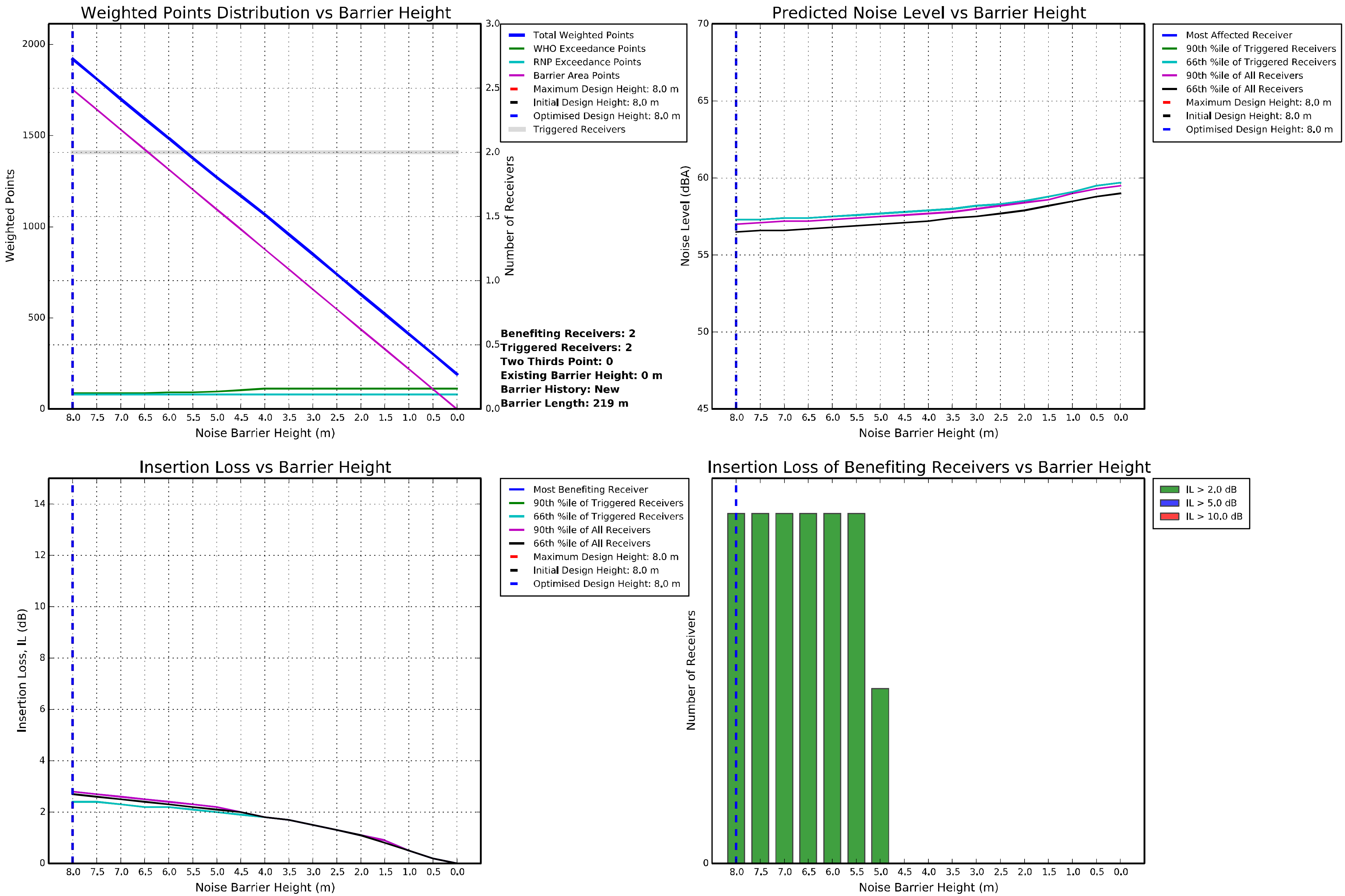



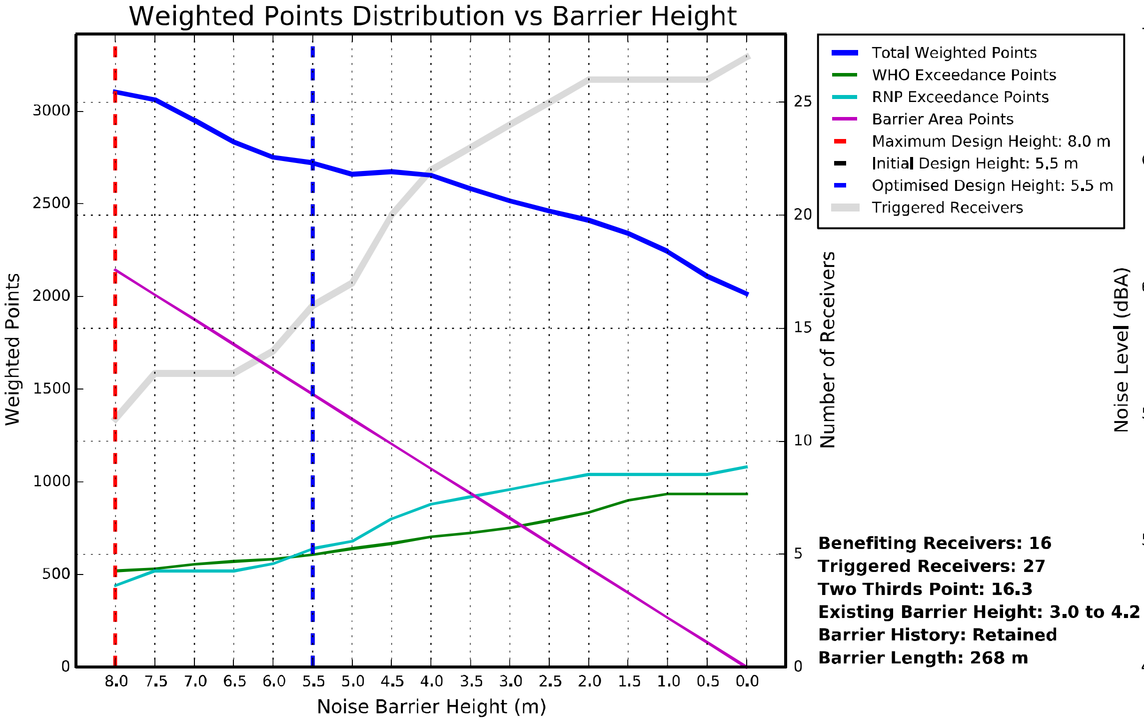
# Noise Barrier Optimisation: NW_M4EB_01F



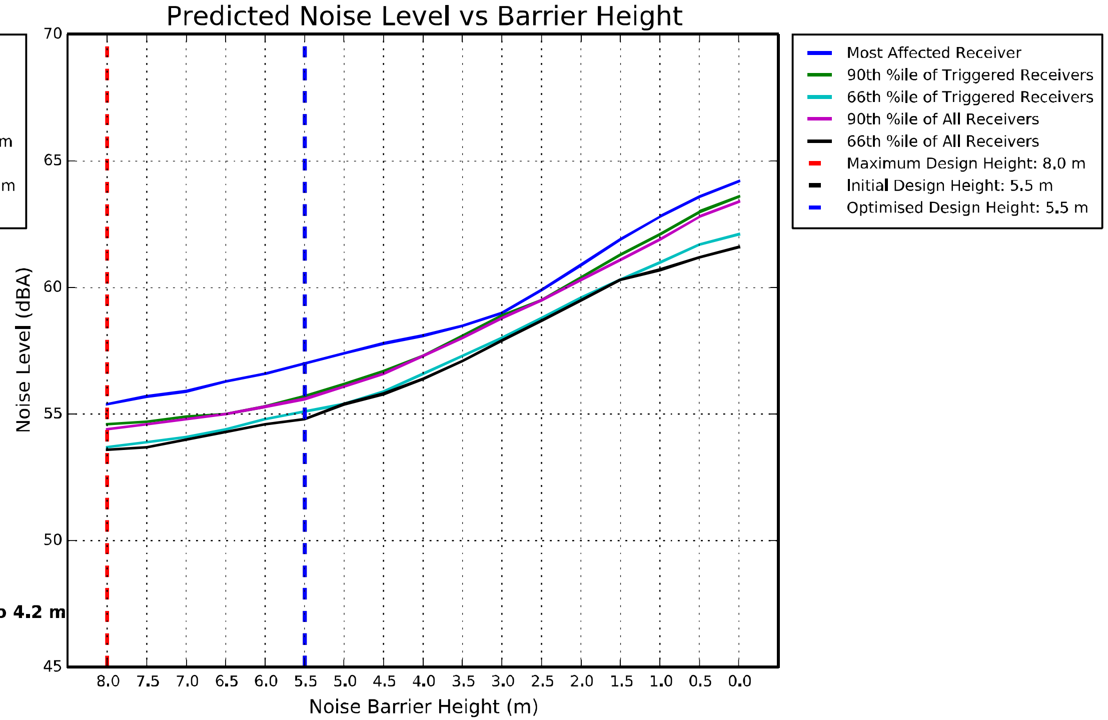
# Noise Barrier Optimisation: NW_M4WB_01

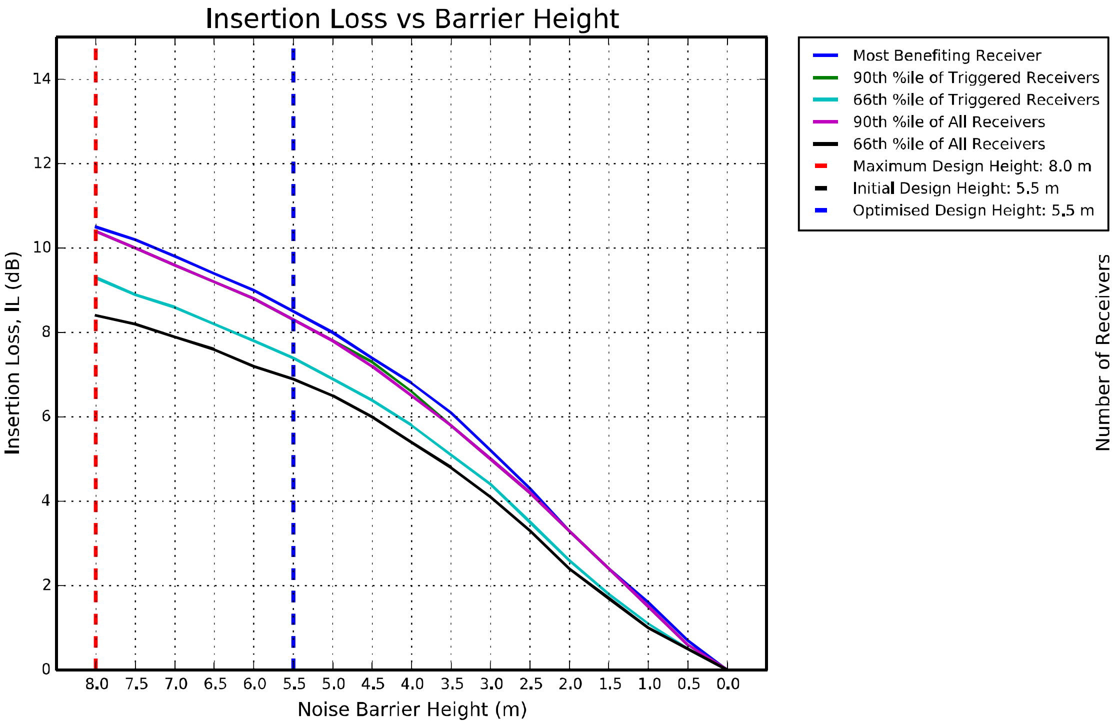


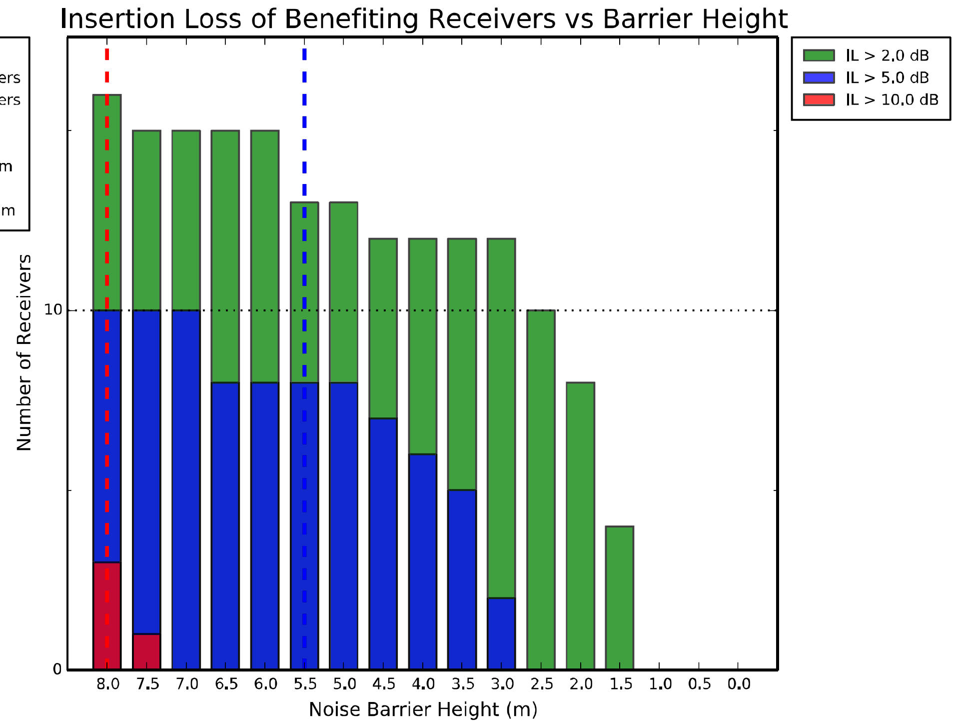
# Noise Barrier Optimisation: NW_M4WB_02A-B



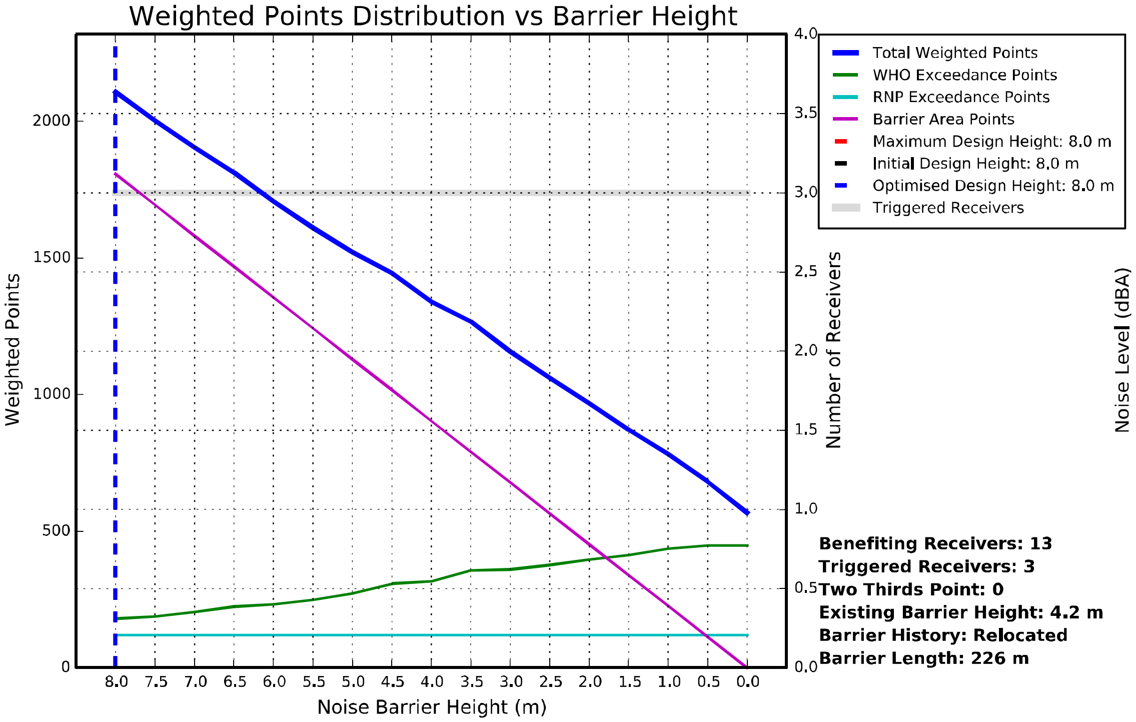

**Benefiting Receivers: 16**
**Triggered Receivers: 27**
**Two Thirds Point: 16.3**
**Existing Barrier Height: 3.0 to 4.2 m**
**Barrier History: Retained**
**Barrier Length: 268 m**



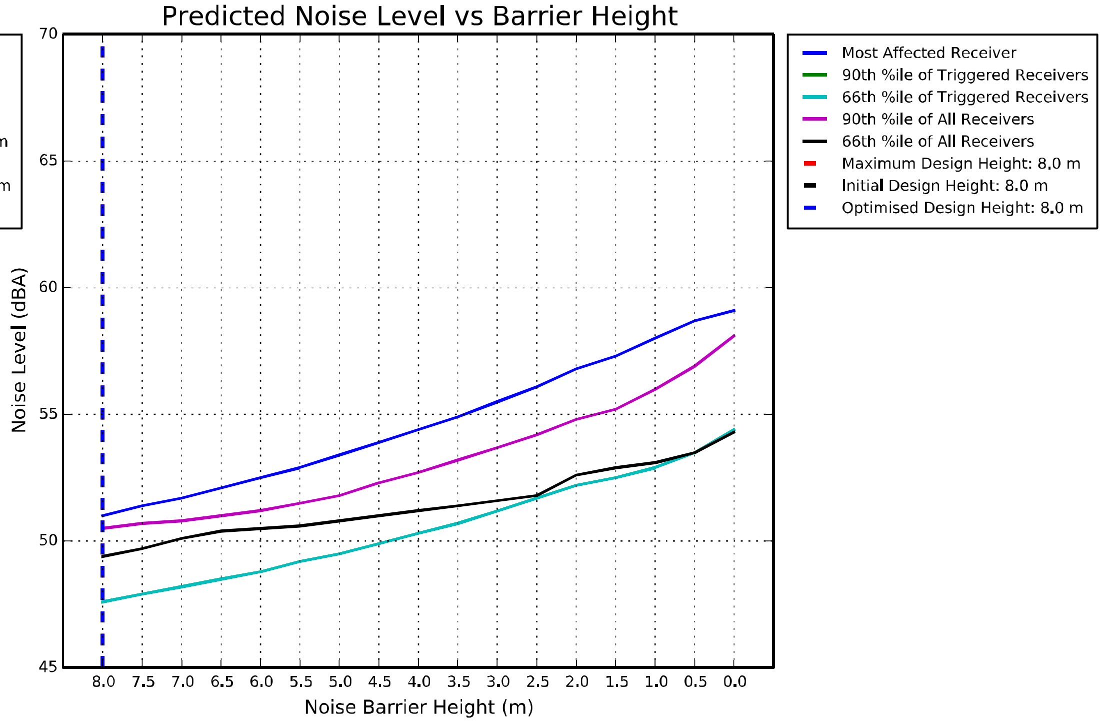



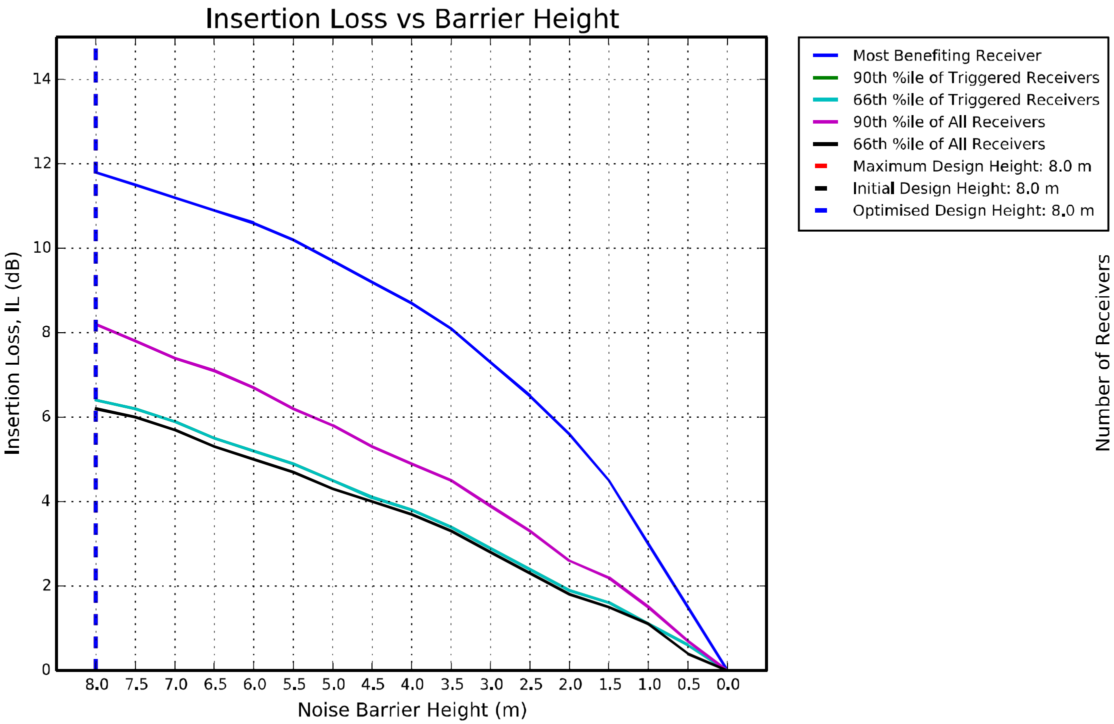



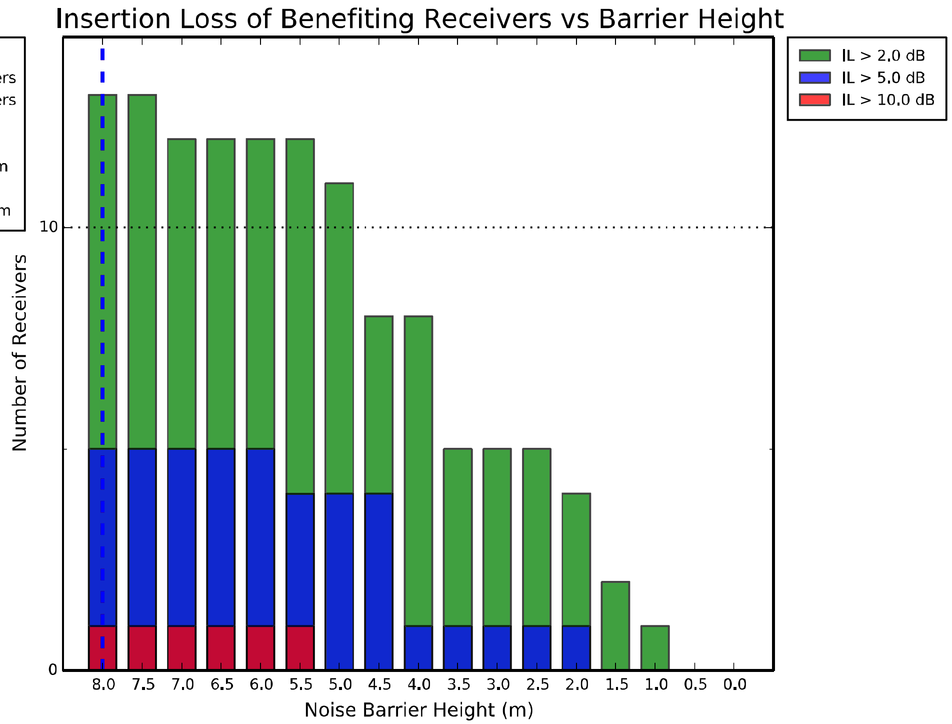
# Noise Barrier Optimisation: NW_M4WB_02C




**Benefiting Receivers: 13**
**Triggered Receivers: 3**
**Two Thirds Point: 0**
**Existing Barrier Height: 4.2 m**
**Barrier History: Relocated**
**Barrier Length: 226 m**



# Appendix F
Report 610.13569-R4

Residential noise predictions, Build (with additional mitigation)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N

0 100 200 300 400 m

Proposed Design
Receiver One Storey
Acquired Buildings
Receiver >One Storey
Low Noise Pavement
Noise Barrier

Predicted Noise Level (LAeq,15hour)

<55 dB
55 - 57 dB
>65 dB
57 - 59 dB
59 - 61 dB
61 - 63 dB
63 - 65 dB

WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions**
**2021, Daytime**
**Build (With Mitigation)**



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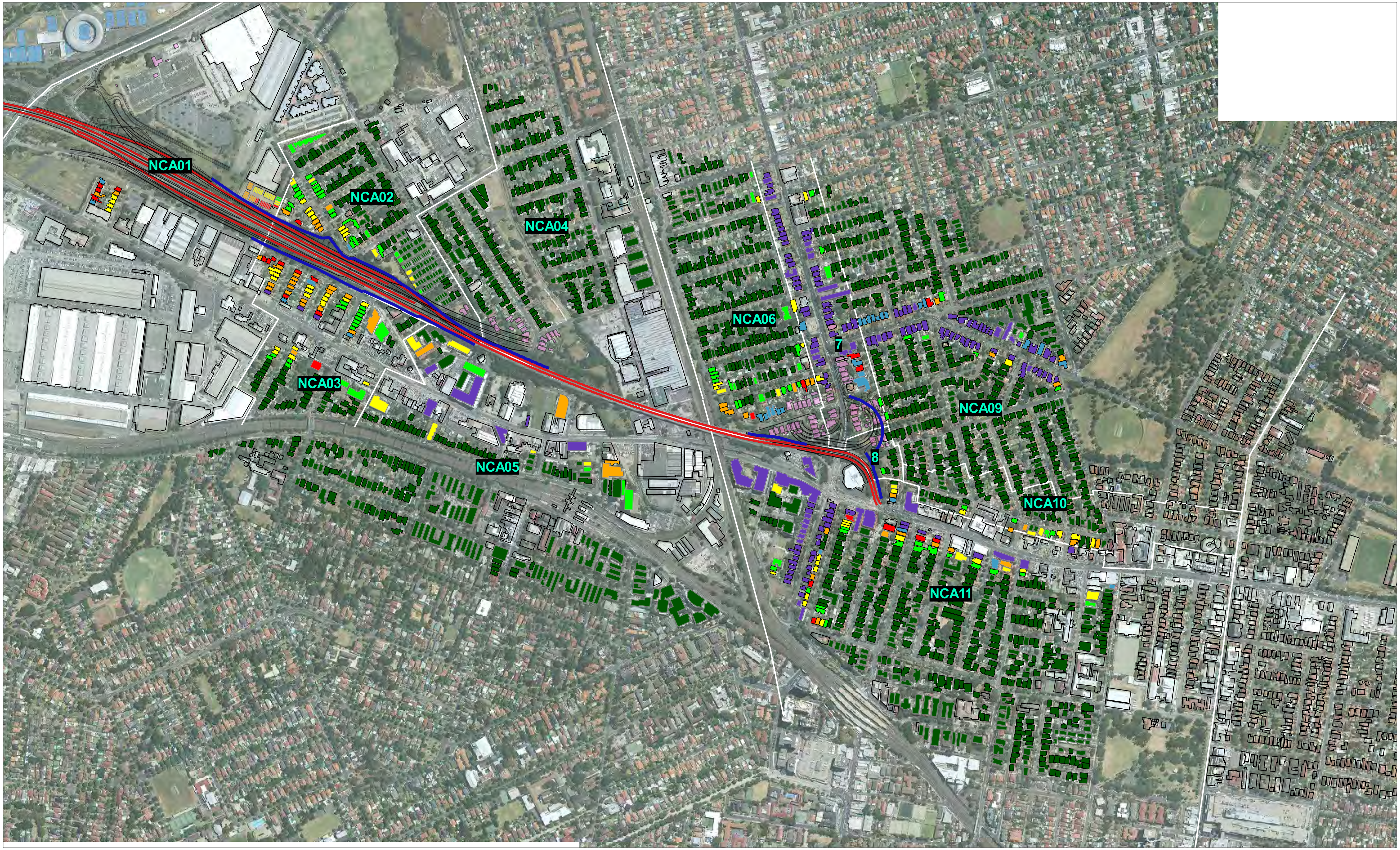
**WestConnex - M4 East**

**Residential Noise Predictions 2021, Night-time Build (With Mitigation)**





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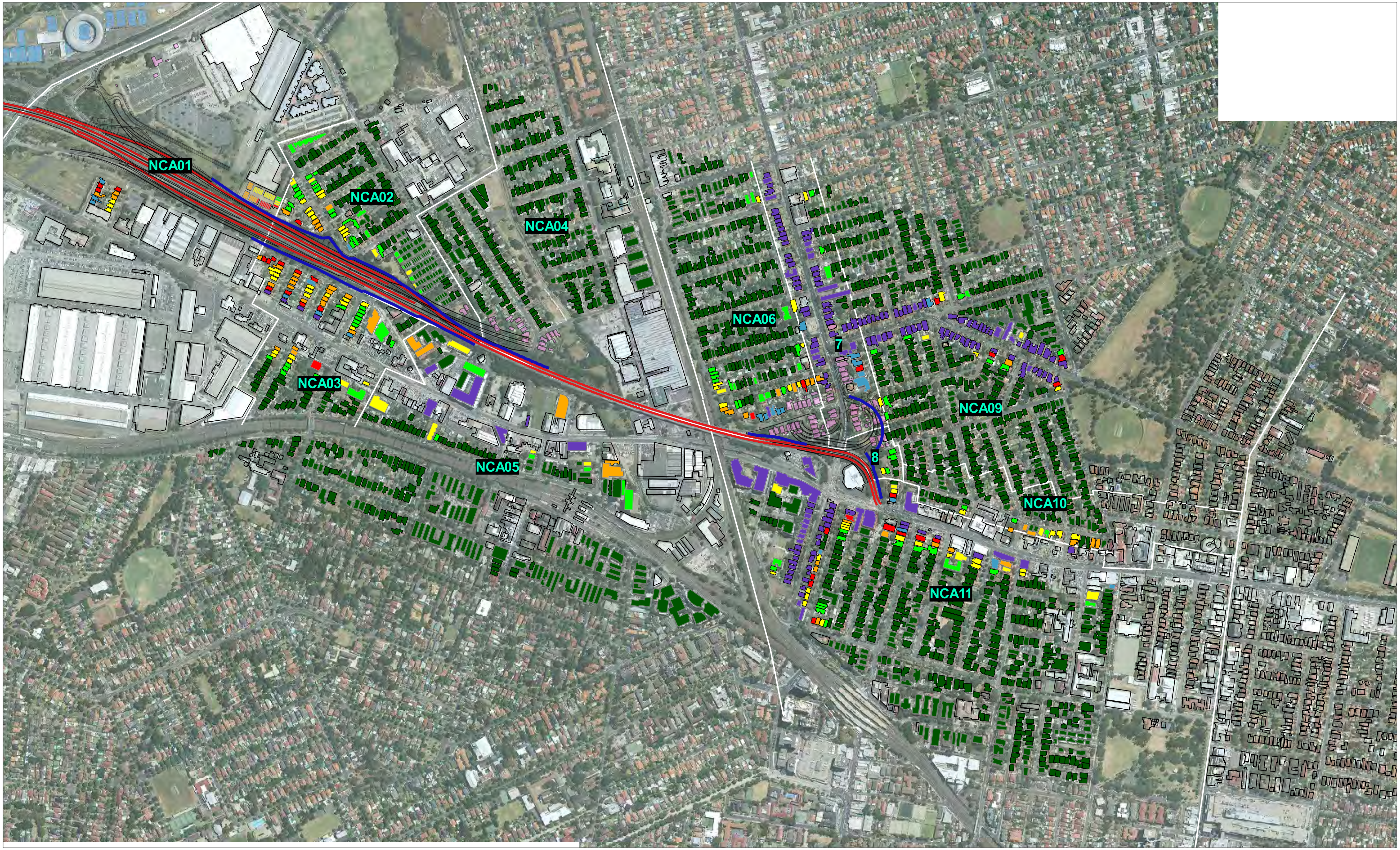
**WestConnex - M4 East**

**Residential Noise Predictions**
**2031, Daytime**
**Build (With Mitigation)**

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Proposed Design
Acquired Buildings
Low Noise Pavement
Receiver One Storey
Receiver >One Storey
Noise Barrier

Predicted Noise Level (LAeq,9hour)

- <50 dB
- 50 - 52 dB
- >60 dB
- 52 - 54 dB
- 54 - 56 dB
- 56 - 58 dB
- 58 - 60 dB

WestConnex Delivery Authority

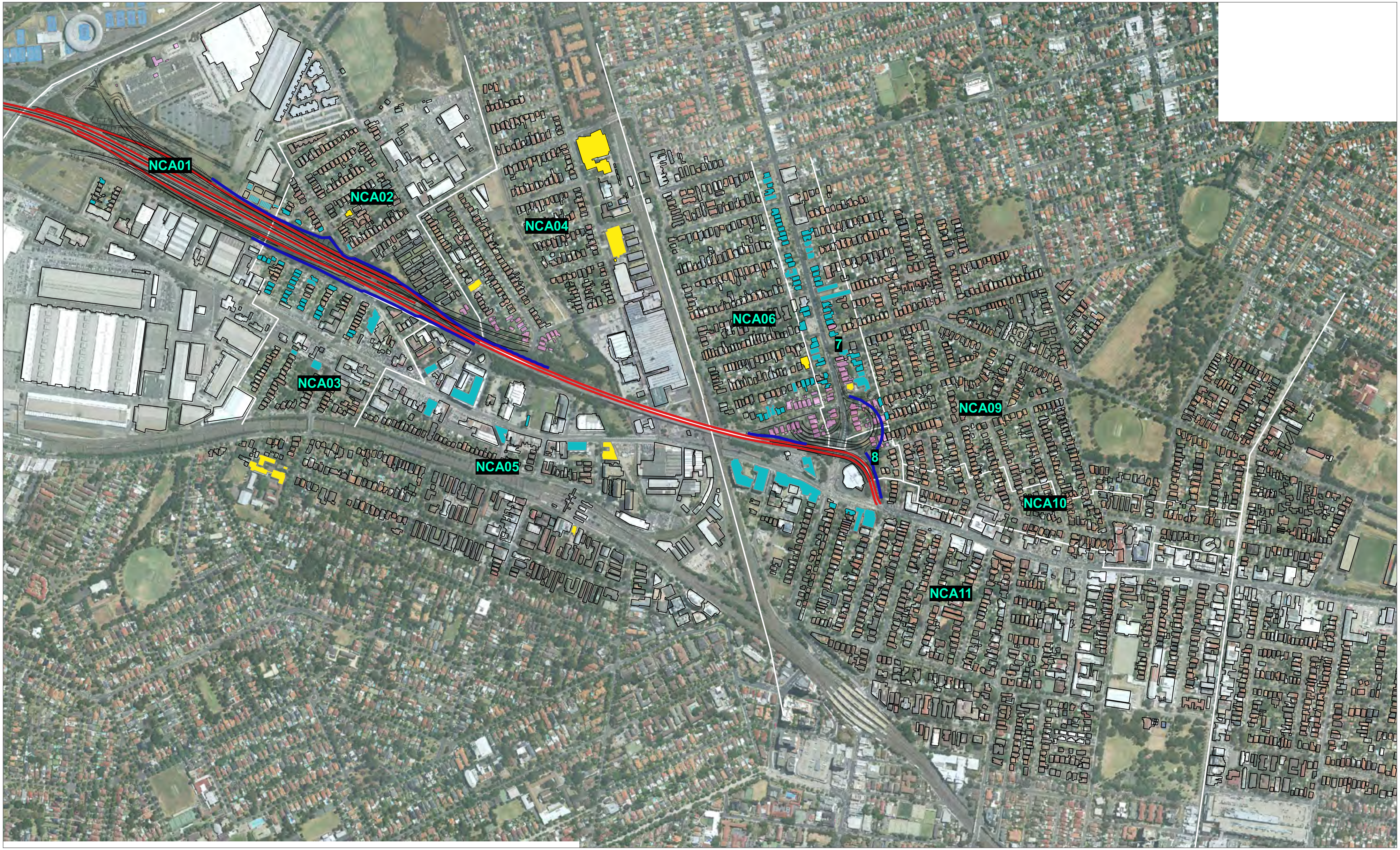
**WestConnex - M4 East**

**Residential Noise Predictions**
**2031, Night-time**
**Build (With Mitigation)**

# Appendix G

Report 610.13569-R4

At-property treatment locations





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N

0 100 200 300 400 m

Proposed Design
Acquired Buildings
Low Noise Pavement
Receiver One Storey
Receiver >One Storey
Noise Barrier

**Receiver Types**

Residential Receiver
Other Sensitive
Outdoor Active/Passive

**WestConnex Delivery Authority**

**WestConnex - M4 East**

**At-Property Treatment Locations Build (With Mitigation)**

# WESTCONNEX M4 EAST
# OPERATIONAL ROAD TRAFFIC NOISE IMPACT ASSESSMENT
# DESIGN CHANGE - WATTLE STREET (CITY WEST LINK) INTERCHANGE

## Appendix A to G

## 1 Sound Level or Noise Level

The terms ‘sound’ and ‘noise’ are almost interchangeable, except that in common usage ‘noise’ is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or $L_P$ are commonly used to represent Sound Pressure Level. The symbol $L_A$ represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x $10^{-5}$ Pa.

## 2 ‘A’ Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an ‘A-weighting’ filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

| Sound Pressure Level (dBA) | Typical Source | Subjective Evaluation |
|---|---|---|
| 130 | Threshold of pain | Intolerable |
| 120 | Heavy rock concert | Extremely noisy |
| 110 | Grinding on steel | |
| 100 | Loud car horn at 3 m | Very noisy |
| 90 | Construction site with pneumatic hammering | |
| 80 | Kerbside of busy street | Loud |
| 70 | Loud radio or television | |
| 60 | Department store | Moderate to quiet |
| 50 | General Office | |
| 40 | Inside private office | Quiet to very quiet |
| 30 | Inside bedroom | |
| 20 | Recording studio | Almost silent |

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as ‘linear’, and the units are expressed as dB(lin) or dB.

## 3 Sound Power Level

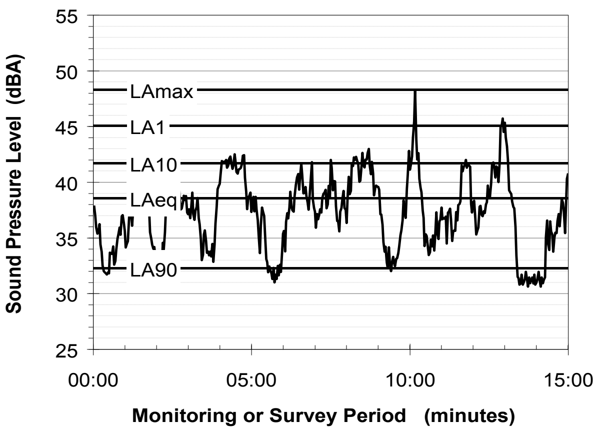
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or $L_W$, or by the reference unit $10^{-12}$ W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

## 4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels $L_{AN}$, where $L_{AN}$ is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the $L_{A1}$ is the noise level exceeded for 1% of the time, $L_{A10}$ the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.




Of particular relevance, are:

$L_{A1}$ The noise level exceeded for 1% of the 15 minute interval.

$L_{A10}$ The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

$L_{A90}$ The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

$L_{Aeq}$ The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the ‘repeatable minimum’ $L_{A90}$ noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or ‘average’ levels representative of the other descriptors ($L_{Aeq}$, $L_{A10}$, etc).

## 5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than ‘broad band’ noise.

## 6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

## 7 Frequency Analysis

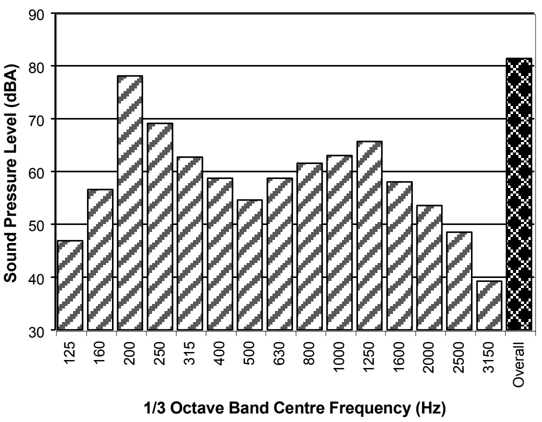
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.




## 8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log ($V/V_o$), where $V_o$ is the reference level ($10^{-9}$ m/s). Care is required in this regard, as other reference levels may be used by some organizations.

## 9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

## 10 Over-Pressure

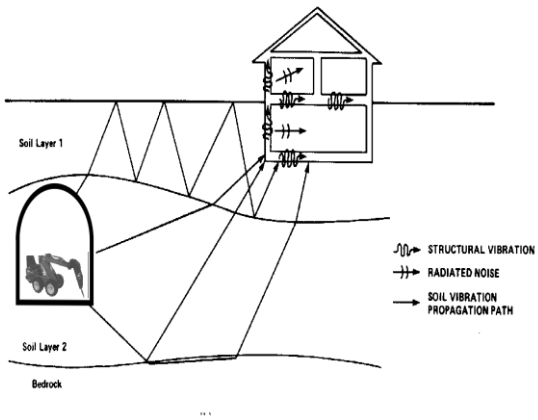
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

## 11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

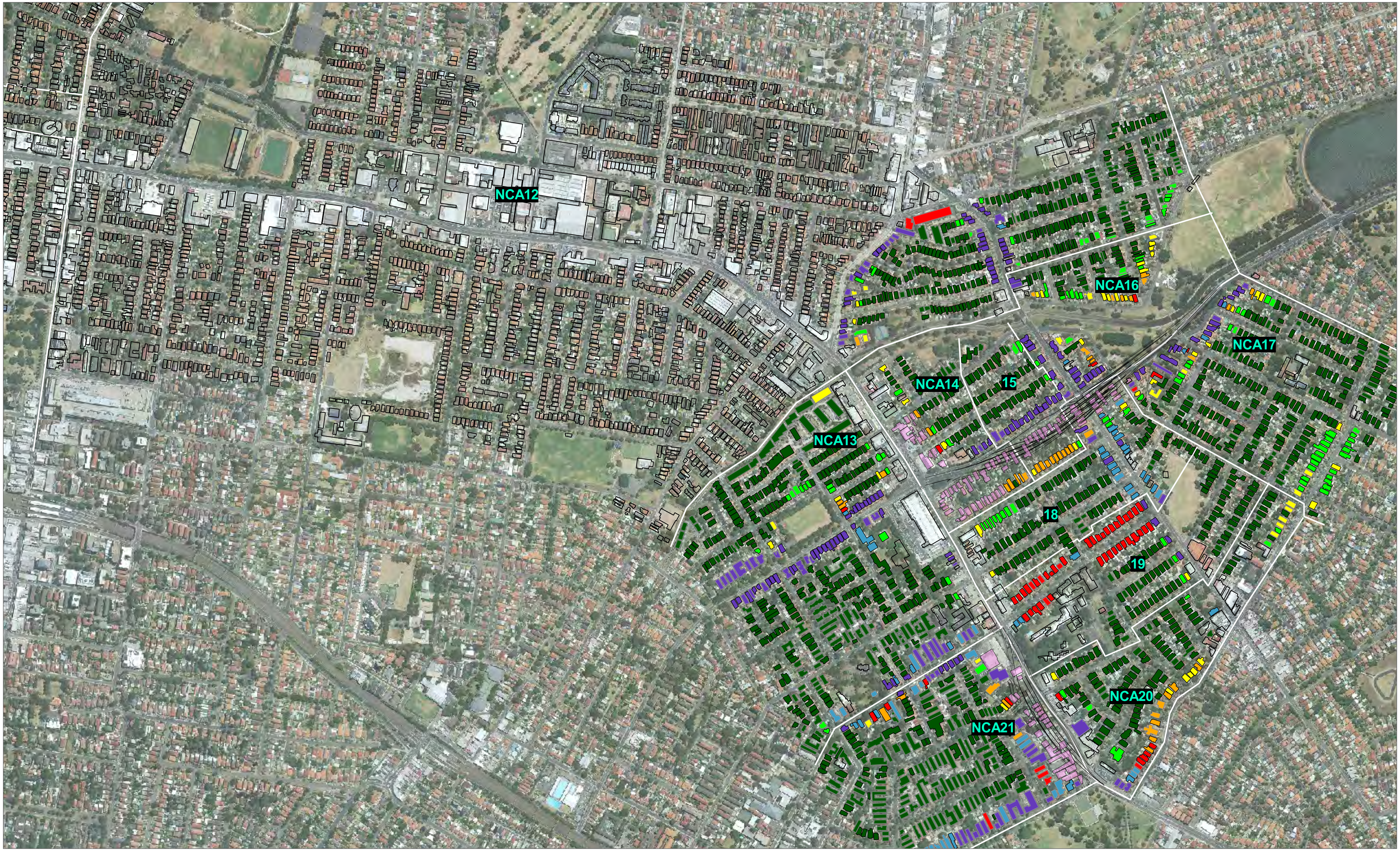
The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.




The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

# Appendix B
Report 610.13569-R5

Residential Noise Predictions - Build

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N

0 100 200 300 400 m

Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
Receiver >One Storey

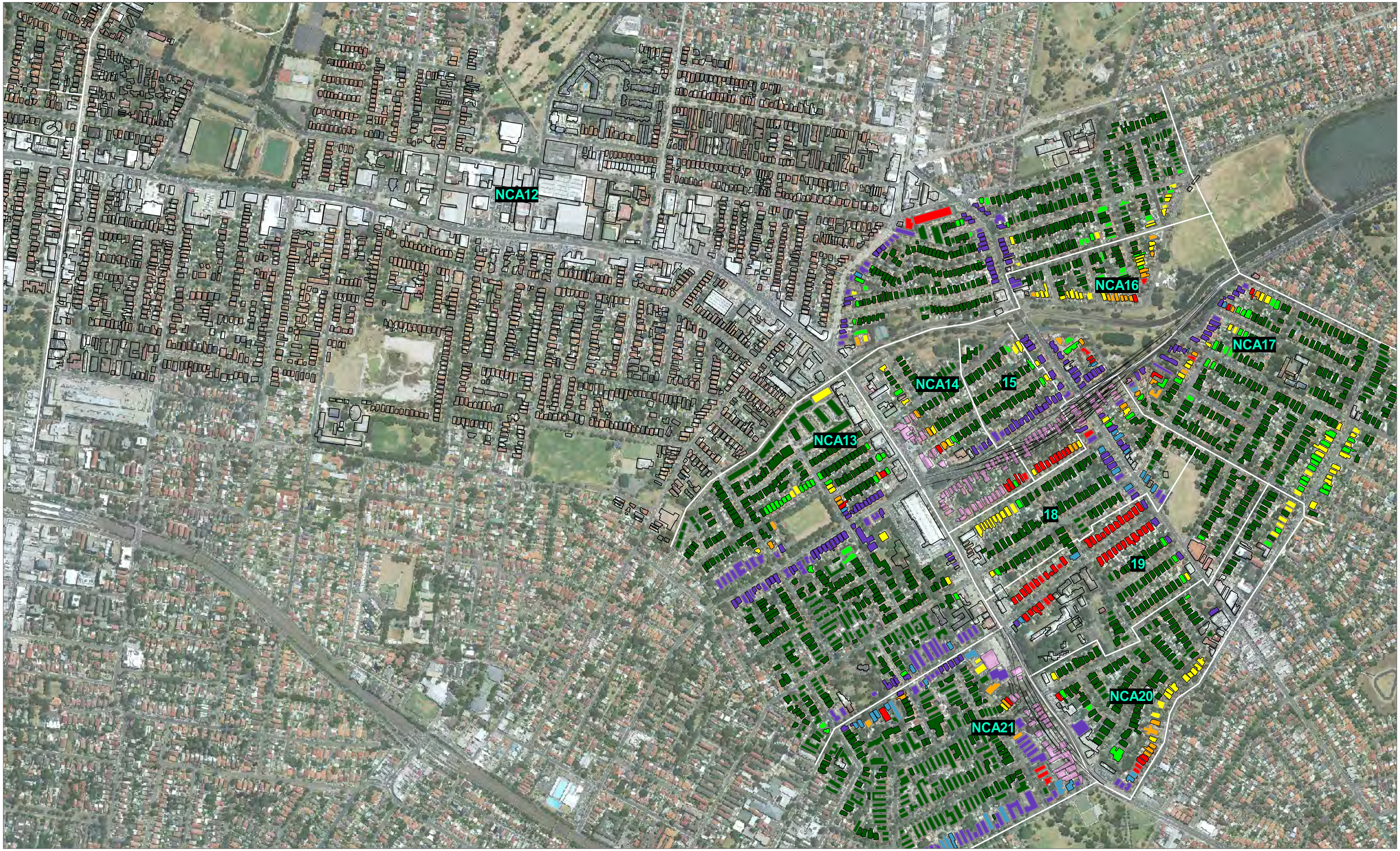
Predicted Noise Level (LAeq,15hour)

- <55 dB
- 55 - 57 dB
- >65 dB
- 57 - 59 dB
- 59 - 61 dB
- 61 - 63 dB
- 63 - 65 dB

**WestConnex Delivery Authority**

**WestConnex - M4 East**

**Residential Noise Predictions 2021, Daytime Build (Without Mitigation)**





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0 100 200 300 400 m

Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
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Predicted Noise Level (LAeq,9hour)

<50 dB
52 - 54 dB
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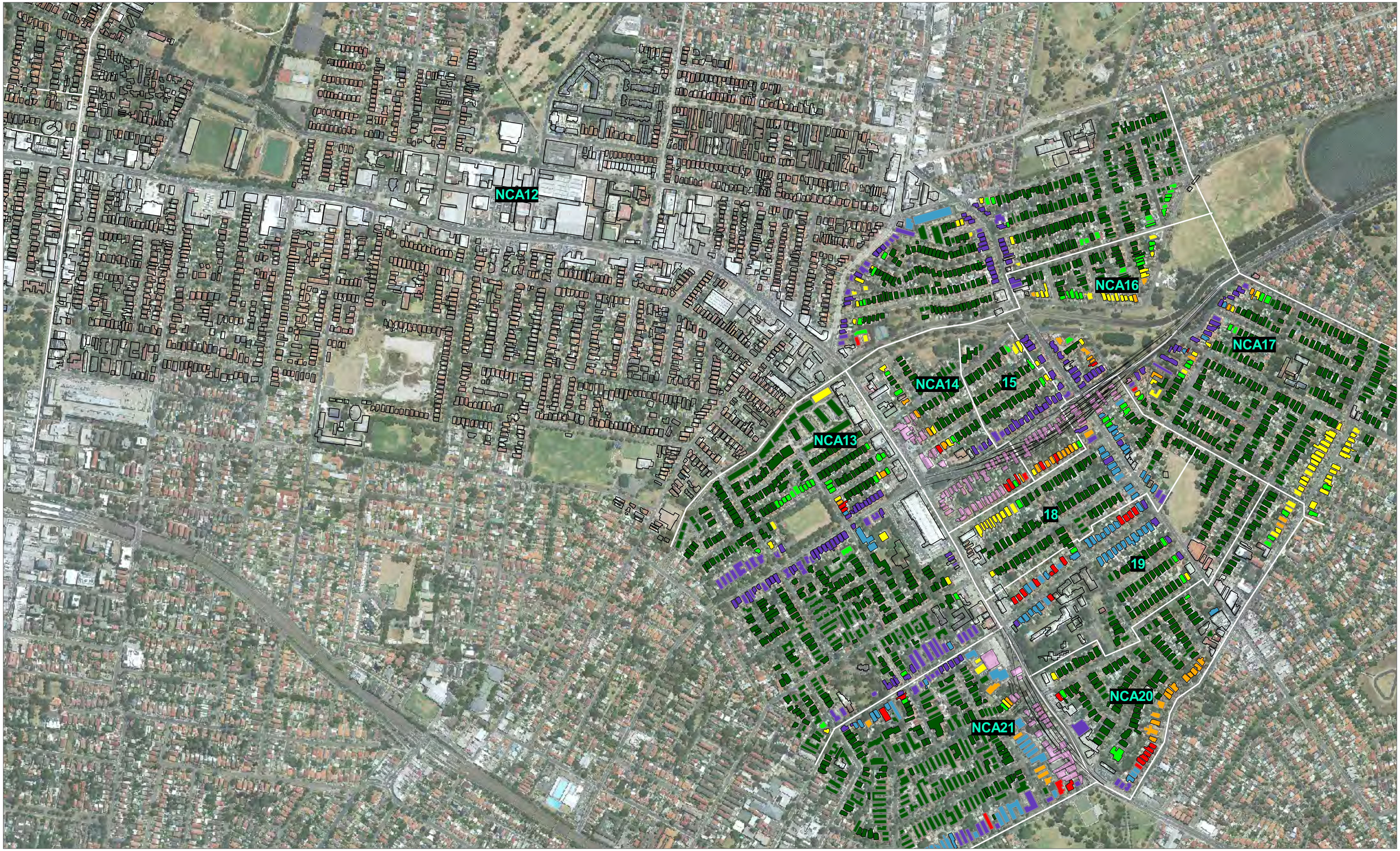
WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions
2021, Night-time
Build (Without Mitigation)**





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0 100 200 300 400 m

Proposed Design
Acquired Buildings
Noise Barrier
Receiver One Storey
Receiver >One Storey

Predicted Noise Level (LAeq,15hour)

<55 dB
57 - 59 dB
61 - 63 dB
55 - 57 dB
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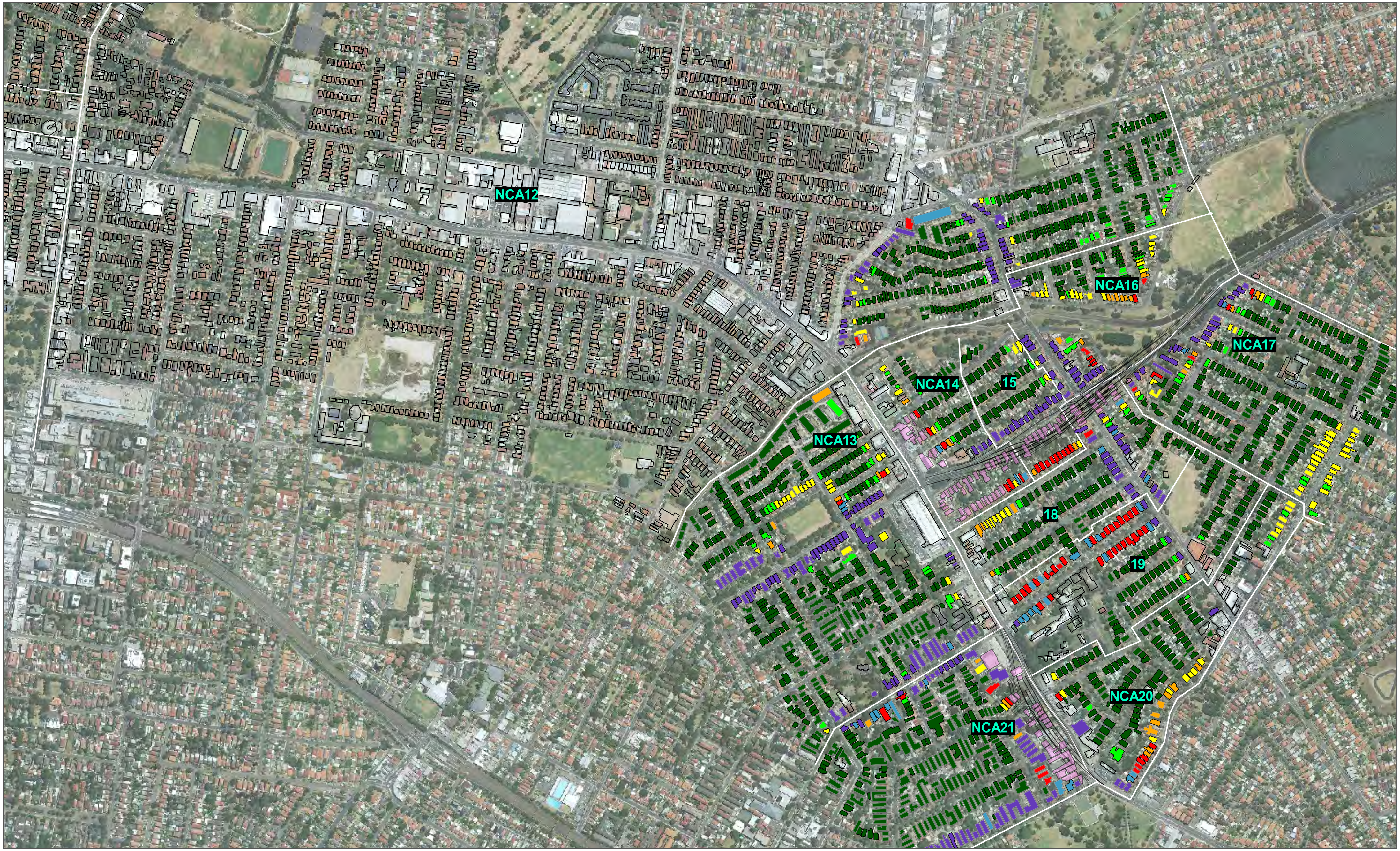
>65 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions 2031, Daytime Build (Without Mitigation)**

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| Projection: | GDA 1994 MGA Zone 56 |

N

0 100 200 300 400 m

Proposed Design
Receiver One Storey
Acquired Buildings
Receiver >One Storey
Noise Barrier

Predicted Noise Level (LAeq,9hour)

<50 dB
50 - 52 dB
>60 dB
52 - 54 dB
54 - 56 dB
56 - 58 dB
58 - 60 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions 2031, Night-time Build (Without Mitigation)**

# Appendix C

Report 610.13569-R5

Additional noise mitigation locations

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N

0 100 200 300 400 m

Proposed Design
Acquired Buildings
Noise Barriers

**Triggered Receivers**

>2.0 dB Increase
Cumulative Limit
Both
Residential
Other Sensitive

**WestConnex Delivery Authority**

**WestConnex - M4 East**

**Receivers Considered for Additional Noise Mitigation Build (Without Additional Mitigation)**

# Appendix D

Report 610.13569-R5

Receivers considered for noise barriers

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0 100 200 300 400 m

Proposed Design
Noise Barrier
Acquired Buildings
Low Noise Pavement

**Triggered Receivers**
>2.0 dB Increase
Cumulative Limit
Both
Residential
Other Sensitive

**WestConnex Delivery Authority**

**WestConnex - M4 East**

**Receivers Considered for Noise Barriers (Low Noise Pavement Included)**

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# Appendix E

Report 610.13569-R5

Noise barrier optimisation analysis

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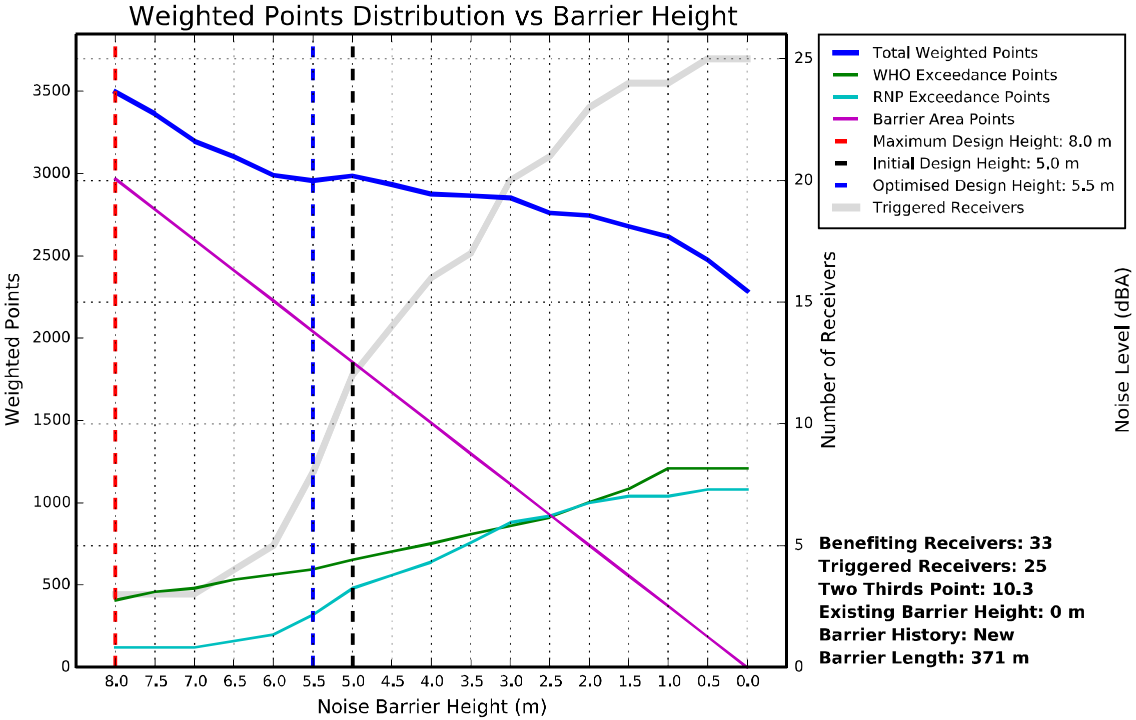
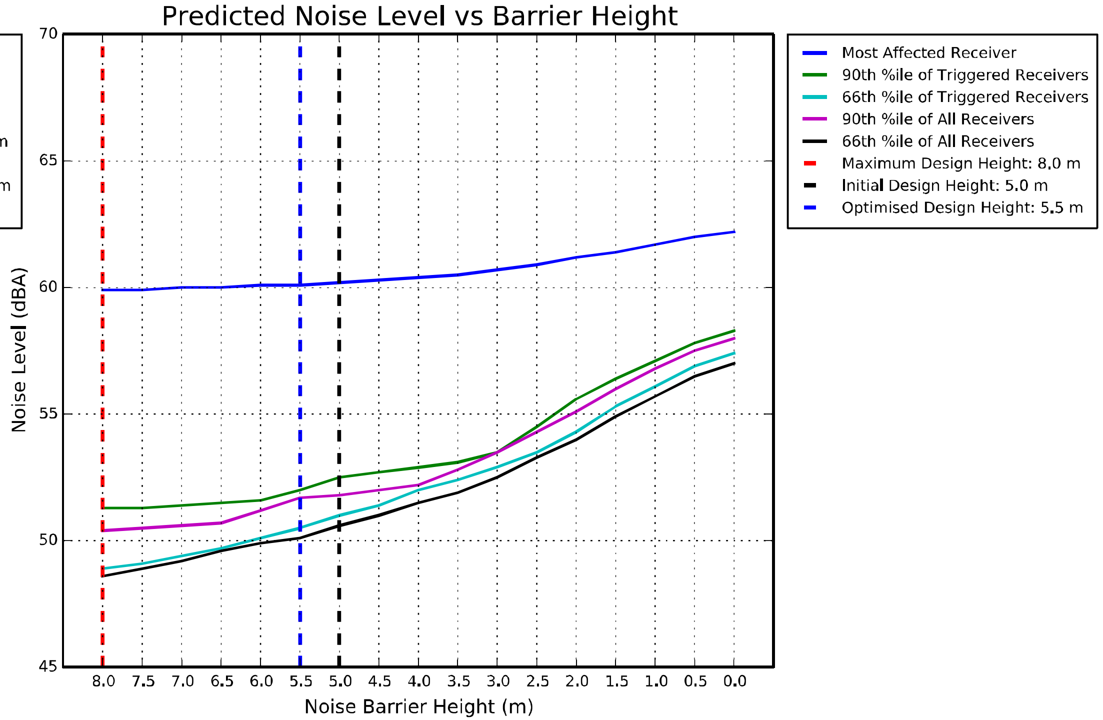
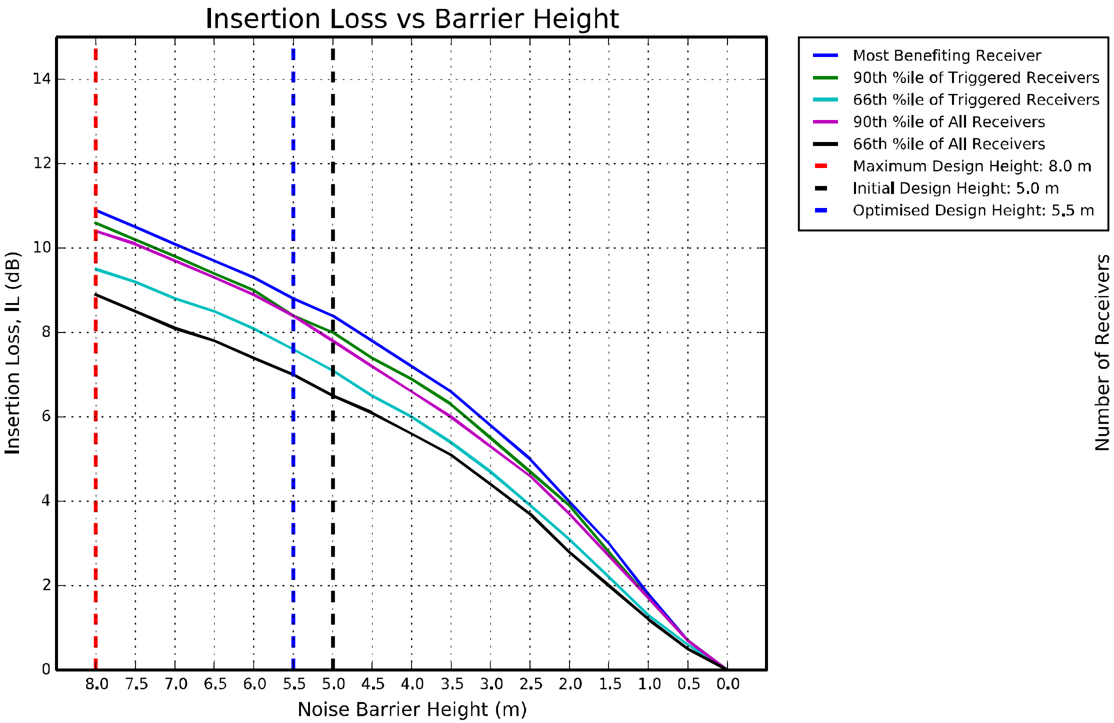
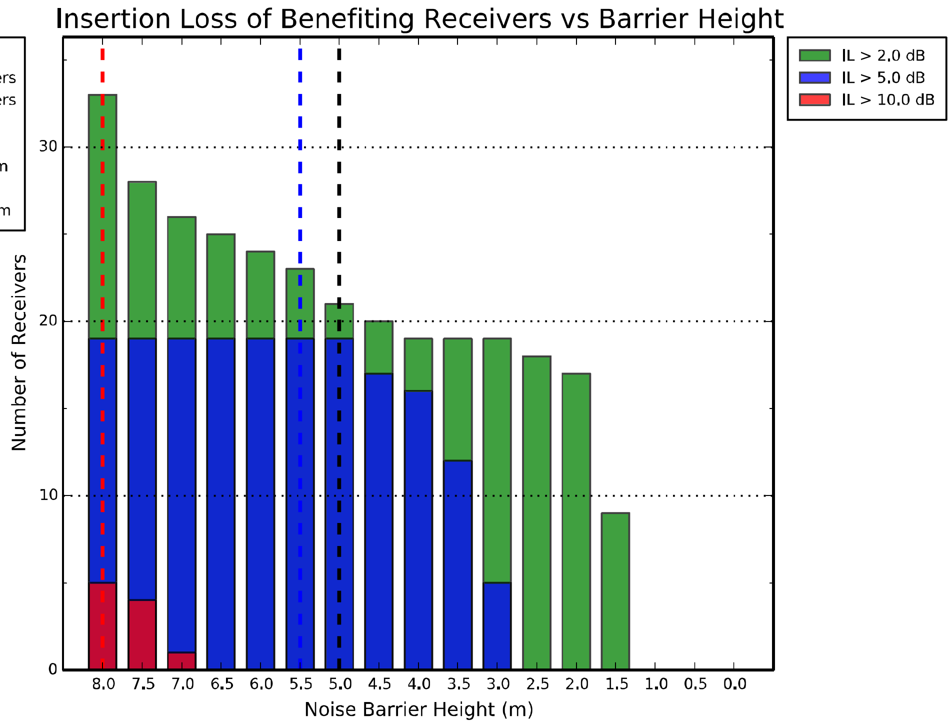
# Noise Barrier Optimisation: NW_WATTLE_01A



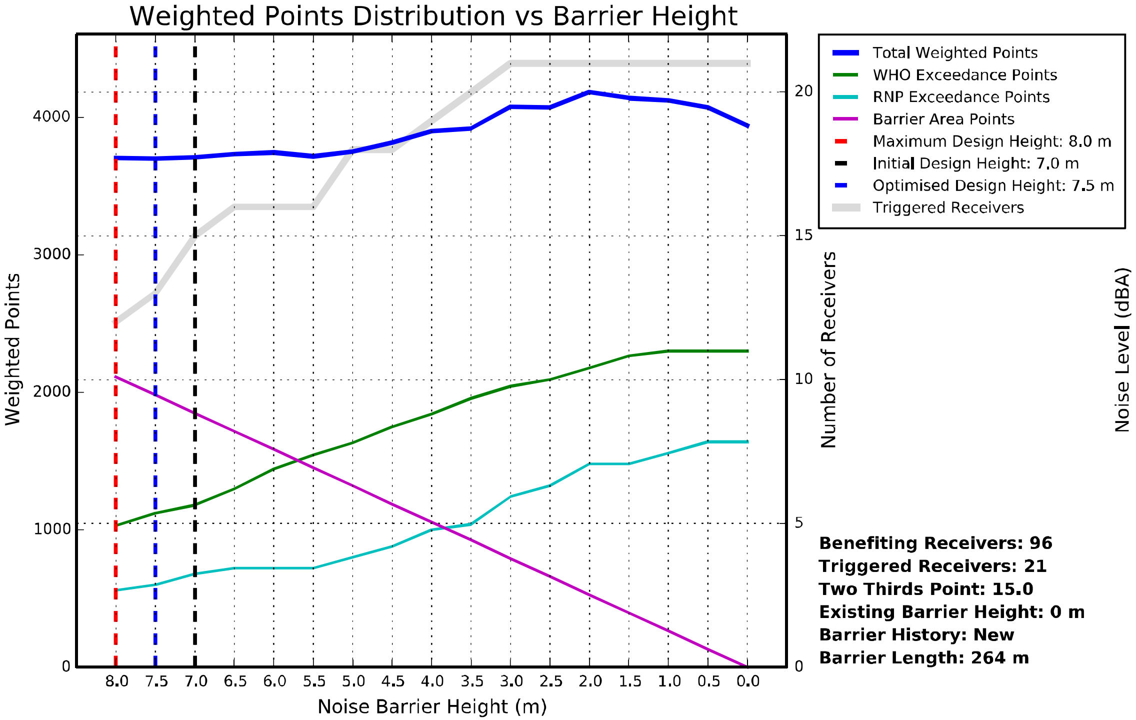

**Benefiting Receivers: 33**
**Triggered Receivers: 25**
**Two Thirds Point: 10.3**
**Existing Barrier Height: 0 m**
**Barrier History: New**
**Barrier Length: 371 m**



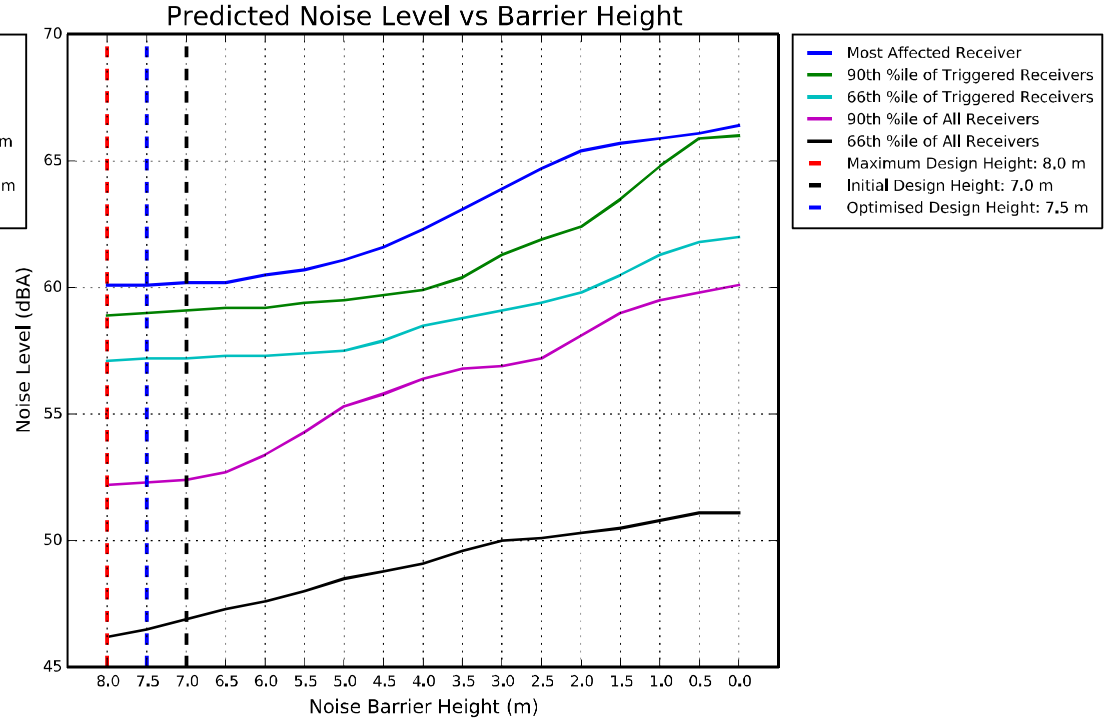



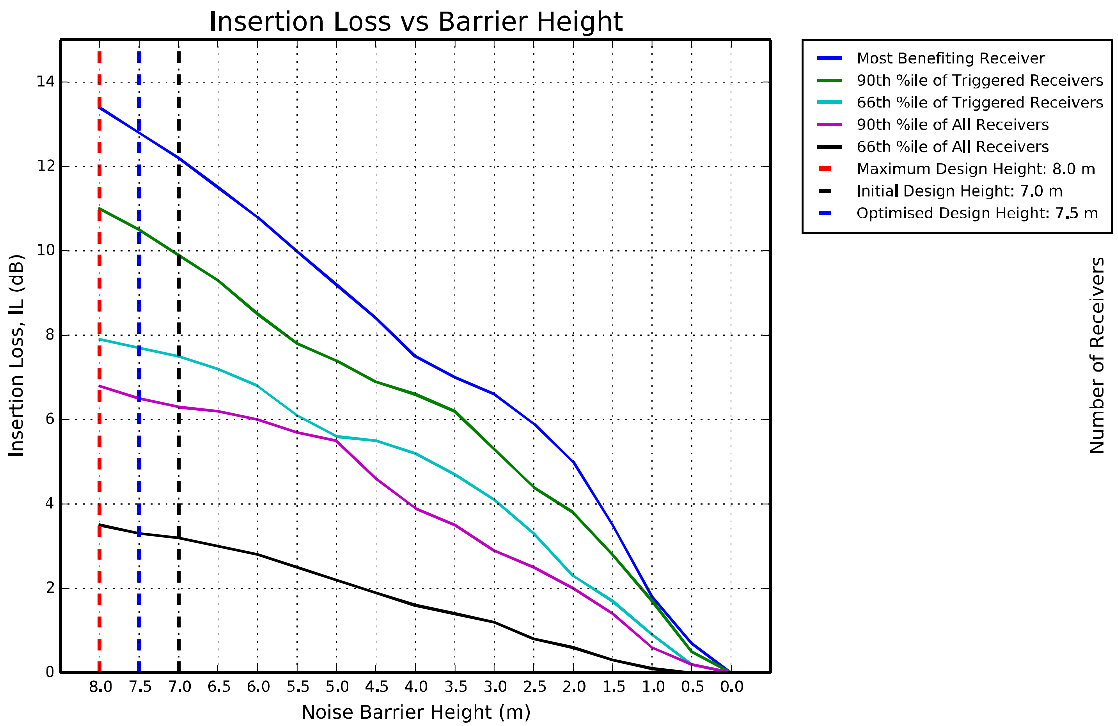



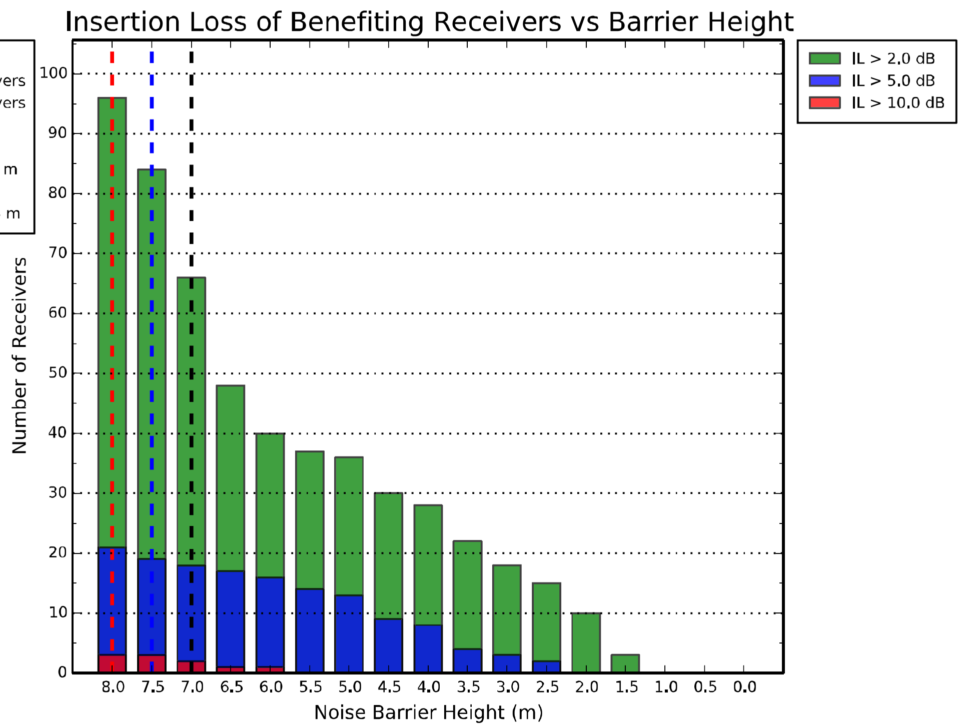
# Noise Barrier Optimisation: NW_WATTLE_01B-F



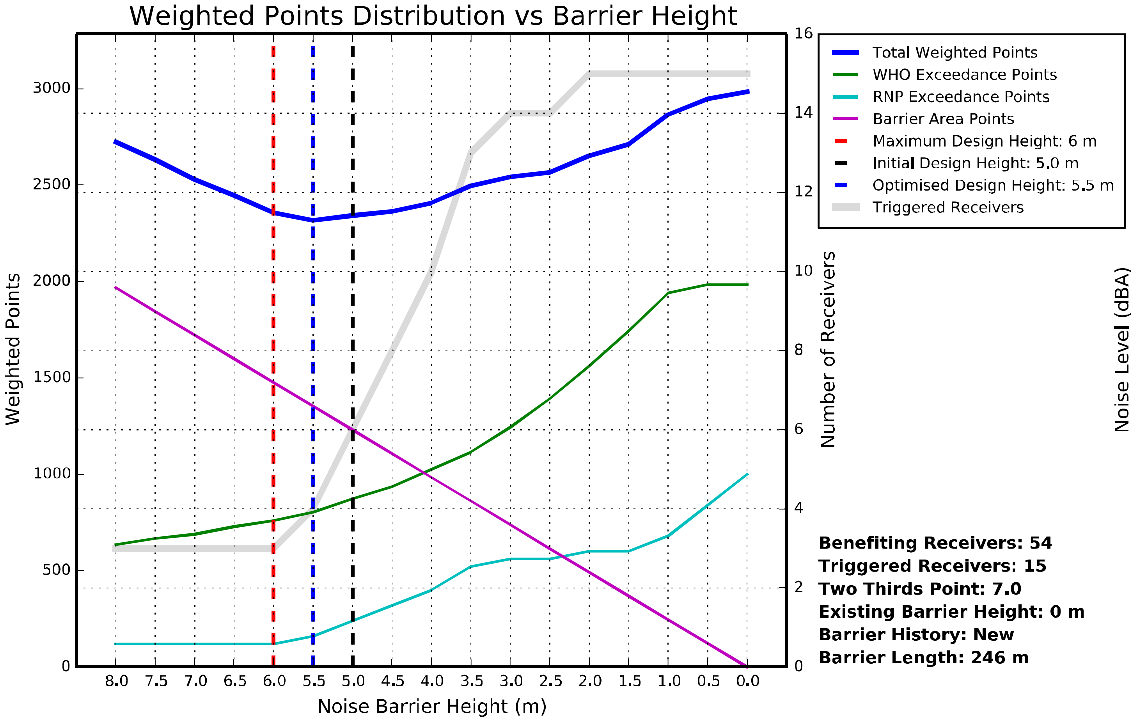

**Benefiting Receivers: 96**
**Triggered Receivers: 21**
**Two Thirds Point: 15.0**
**Existing Barrier Height: 0 m**
**Barrier History: New**
**Barrier Length: 264 m**

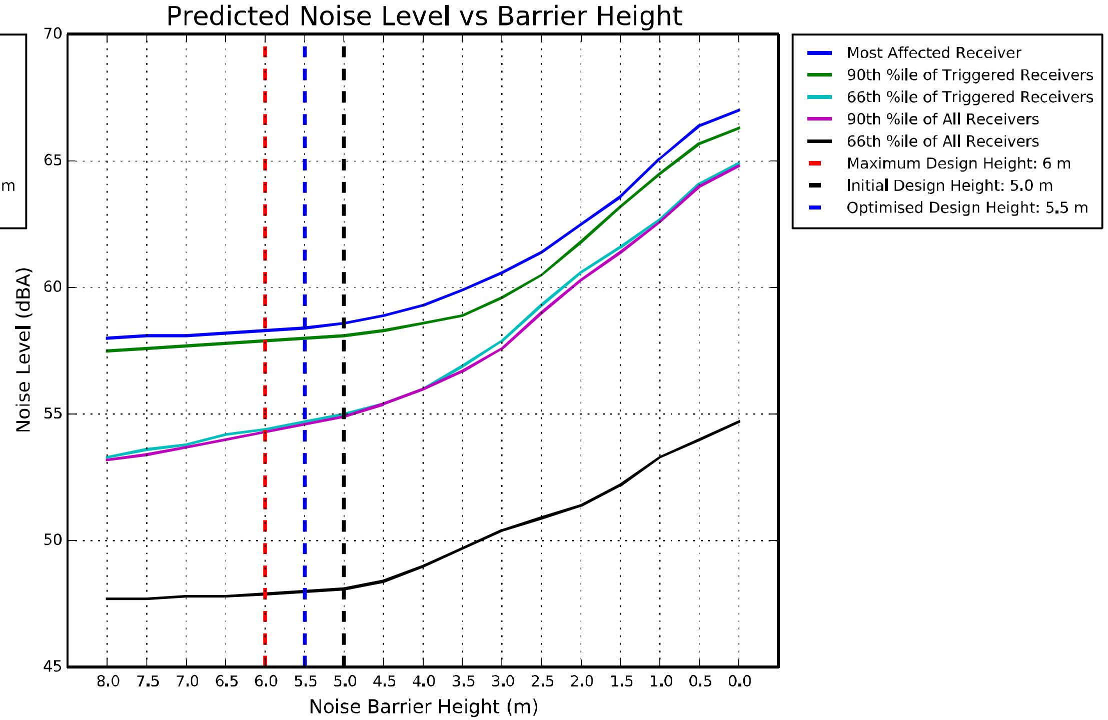


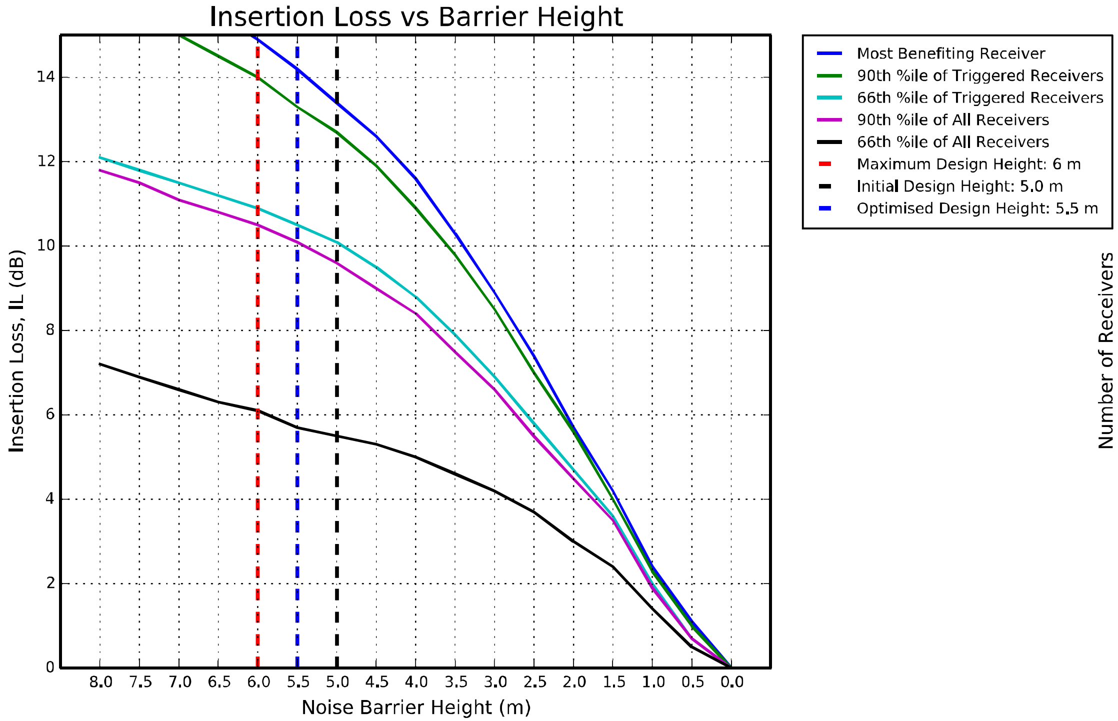



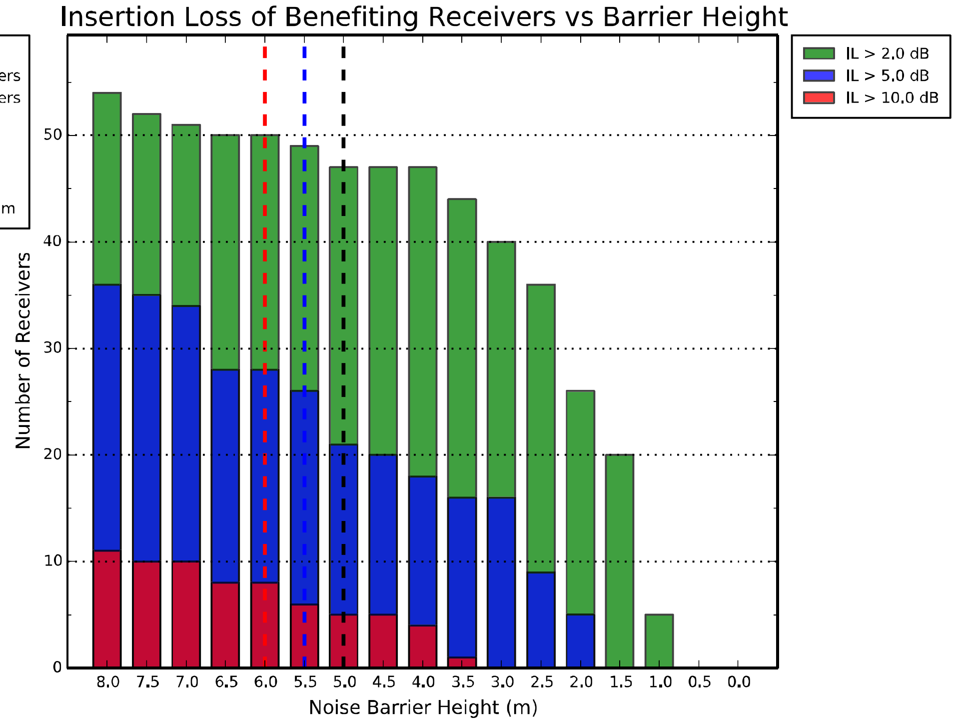



# Noise Barrier Optimisation: NW_WATTLE_01G



# Appendix F

Report 610.13569-R5

Residential noise predictions, Build (with additional mitigation)

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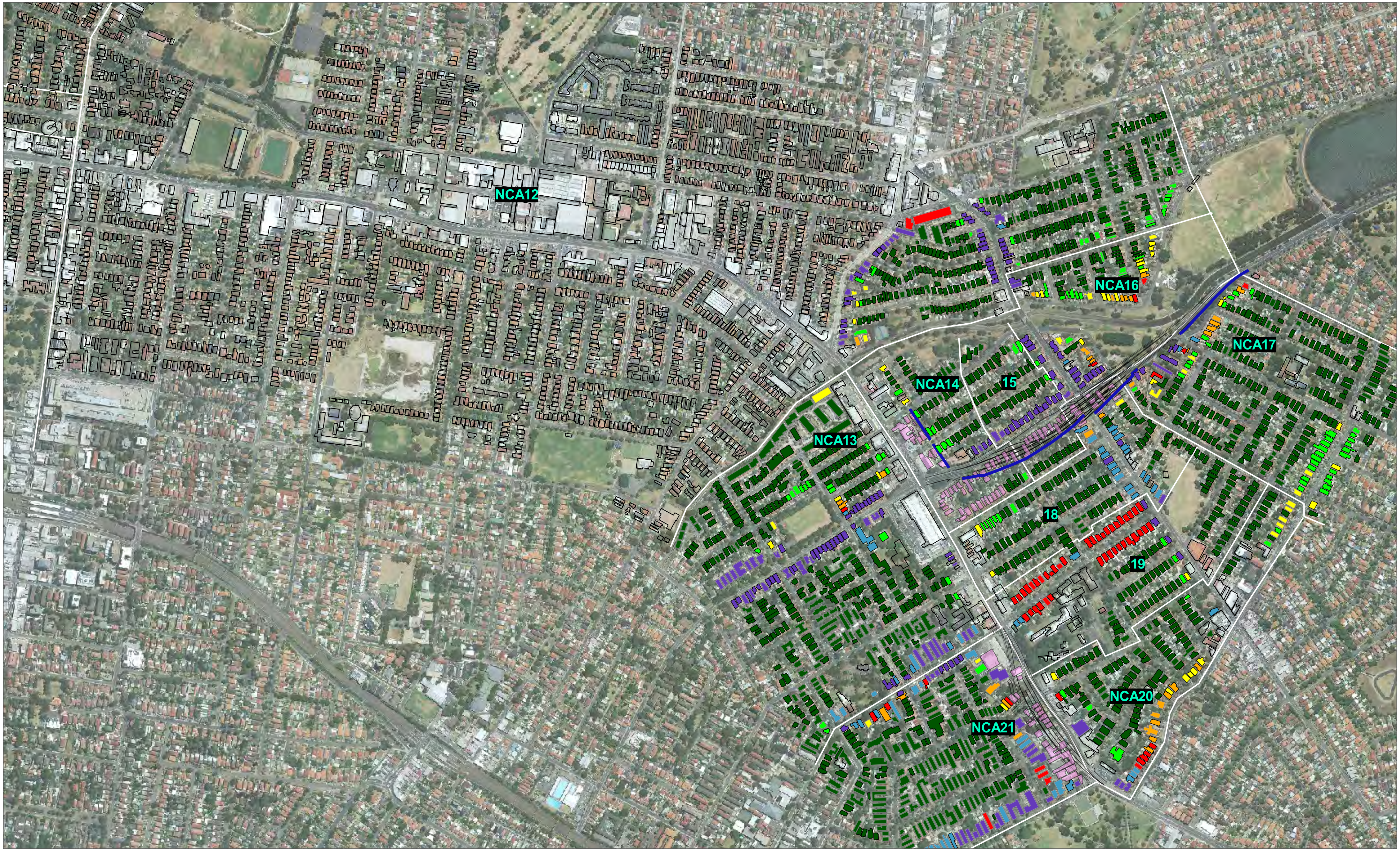



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Proposed Design
Acquired Buildings
Low Noise Pavement
Receiver One Storey
Receiver >One Storey
Noise Barrier

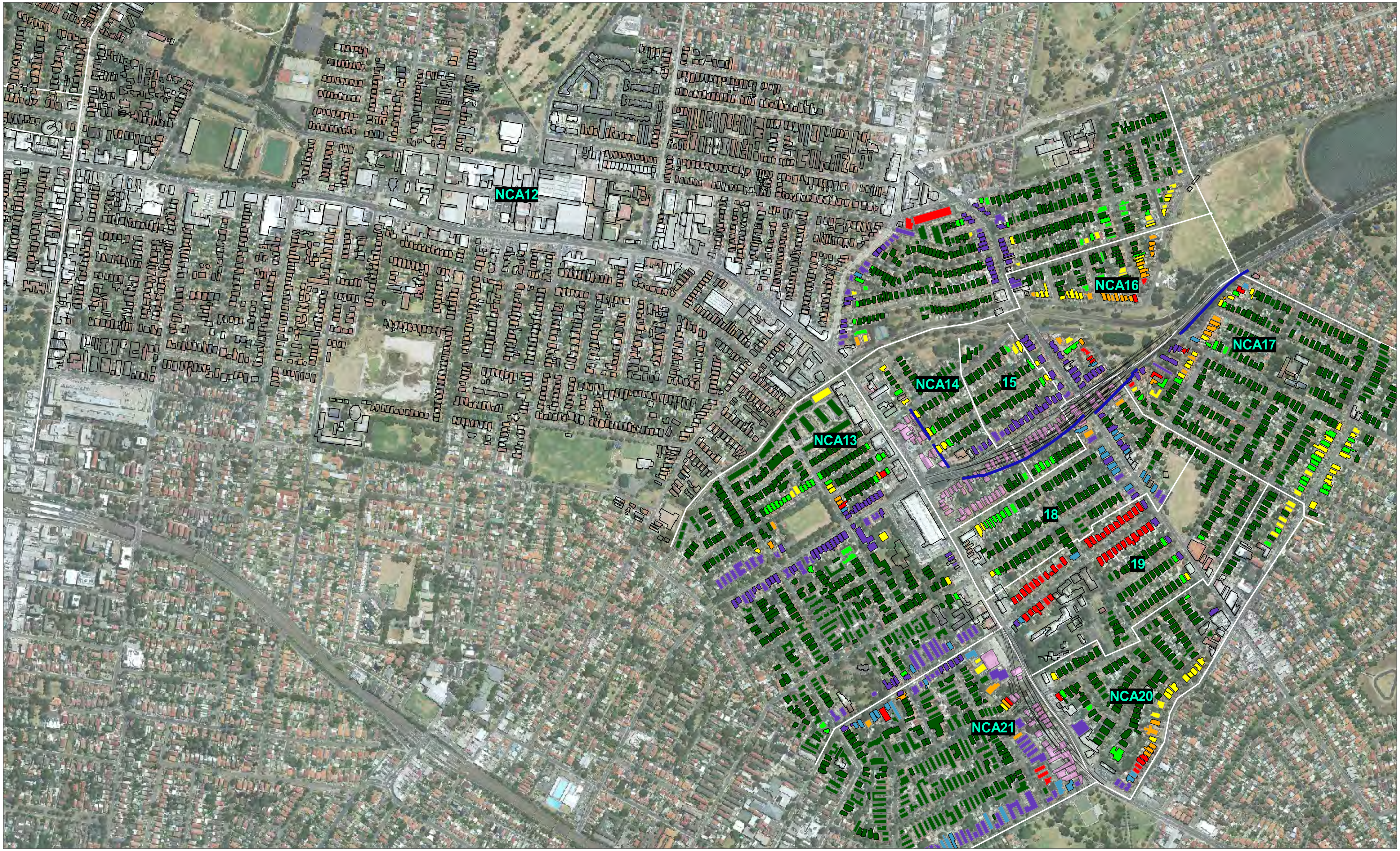
Predicted Noise Level (LAeq,15hour)

<55 dB
57 - 59 dB
61 - 63 dB
55 - 57 dB
59 - 61 dB
63 - 65 dB
>65 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions 2021, Daytime Build (With Mitigation)**





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N

0 100 200 300 400 m

Proposed Design
Acquired Buildings
Low Noise Pavement
Receiver One Storey
Receiver >One Storey
Noise Barrier

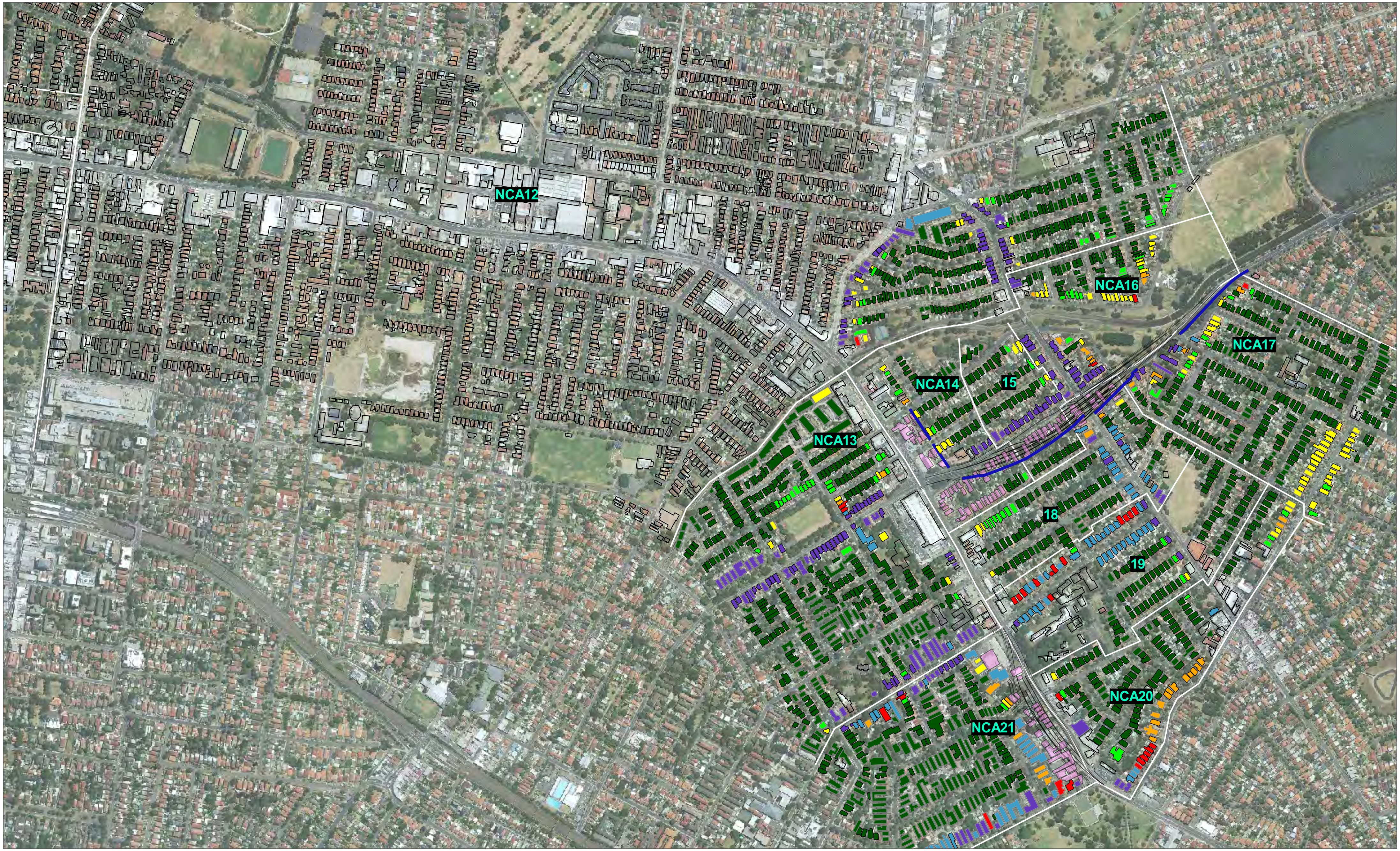
Predicted Noise Level (LAeq,9hour)

<50 dB
52 - 54 dB
56 - 58 dB
50 - 52 dB
54 - 56 dB
58 - 60 dB
>60 dB

WestConnex Delivery Authority

**WestConnex - M4 East**

**Residential Noise Predictions 2021, Night-time Build (With Mitigation)**

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Proposed Design
Acquired Buildings
Low Noise Pavement
Receiver One Storey
Receiver >One Storey
Noise Barrier

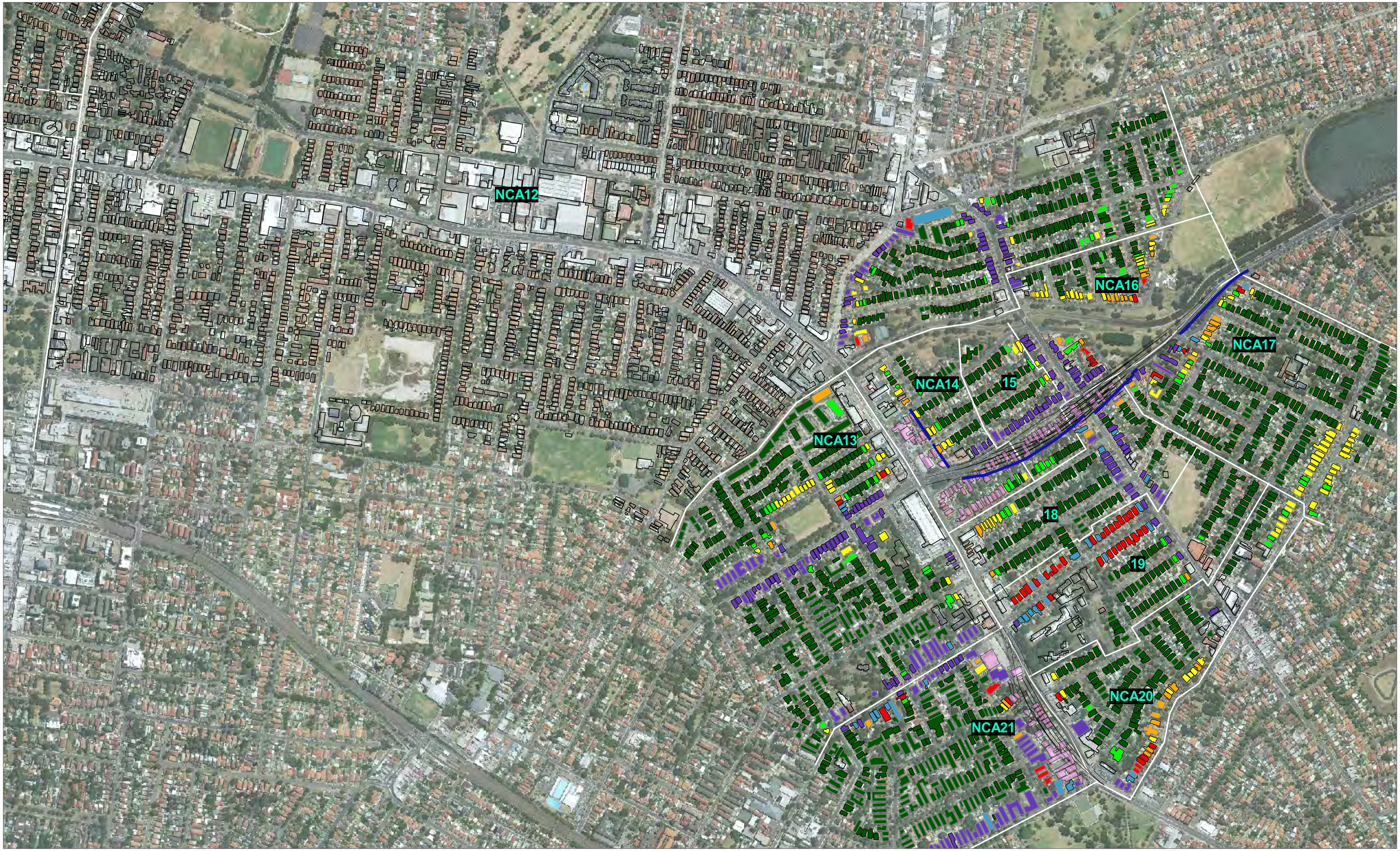
Predicted Noise Level (LAeq,15hour)

<55 dB
57 - 59 dB
61 - 63 dB
55 - 57 dB
59 - 61 dB
63 - 65 dB
>65 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions 2031, Daytime Build (With Mitigation)**

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Proposed Design
Receiver One Storey
Acquired Buildings
Receiver >One Storey
Low Noise Pavement
Noise Barrier

Predicted Noise Level (LAeq,9hour)

<50 dB
50 - 52 dB
>60 dB
52 - 54 dB
54 - 56 dB
56 - 58 dB
58 - 60 dB

WestConnex Delivery Authority

WestConnex - M4 East

**Residential Noise Predictions 2031, Night-time Build (With Mitigation)**

# Appendix G

Report 610.13569-R5

At-property treatment locations


Proposed Design
Receiver One Storey
Acquired Buildings
Receiver >One Storey
Low Noise Pavement
Noise Barrier

**Receiver Types**

Residential Receiver
Other Sensitive
Outdoor Active/Passive


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**WestConnex Delivery Authority**

**WestConnex - M4 East**

**At-Property Treatment Locations Build (With Mitigation)**

# WESTCONNEX M4 EAST
# CONSTRUCTION NOISE IMPACT ASSESSMENT
# AUSGRID SITE COMPOUND

## Appendix A to B

## 1 Sound Level or Noise Level

The terms ‘sound’ and ‘noise’ are almost interchangeable, except that in common usage ‘noise’ is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or $L_P$ are commonly used to represent Sound Pressure Level. The symbol $L_A$ represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x $10^{-5}$ Pa.

## 2 ‘A’ Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an ‘A-weighting’ filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

| Sound Pressure Level (dBA) | Typical Source | Subjective Evaluation |
|---|---|---|
| 130 | Threshold of pain | Intolerable |
| 120 | Heavy rock concert | Extremely noisy |
| 110 | Grinding on steel | |
| 100 | Loud car horn at 3 m | Very noisy |
| 90 | Construction site with pneumatic hammering | |
| 80 | Kerbside of busy street | Loud |
| 70 | Loud radio or television | |
| 60 | Department store | Moderate to quiet |
| 50 | General Office | |
| 40 | Inside private office | Quiet to very quiet |
| 30 | Inside bedroom | |
| 20 | Recording studio | Almost silent |

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as ‘linear’, and the units are expressed as dB(lin) or dB.

## 3 Sound Power Level

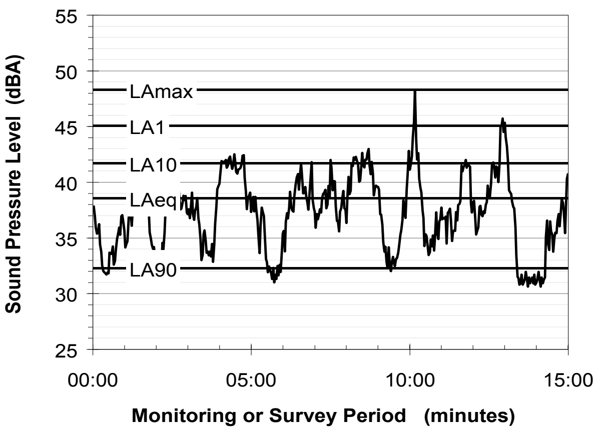
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or $L_W$, or by the reference unit $10^{-12}$ W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

## 4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels $L_{AN}$, where $L_{AN}$ is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the $L_{A1}$ is the noise level exceeded for 1% of the time, $L_{A10}$ the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.




Of particular relevance, are:

- $L_{A1}$ The noise level exceeded for 1% of the 15 minute interval.
- $L_{A10}$ The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- $L_{A90}$ The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- $L_{Aeq}$ The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the ‘repeatable minimum’ $L_{A90}$ noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or ‘average’ levels representative of the other descriptors ($L_{Aeq}$, $L_{A10}$, etc).

## 5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than ‘broad band’ noise.

## 6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

## 7 Frequency Analysis

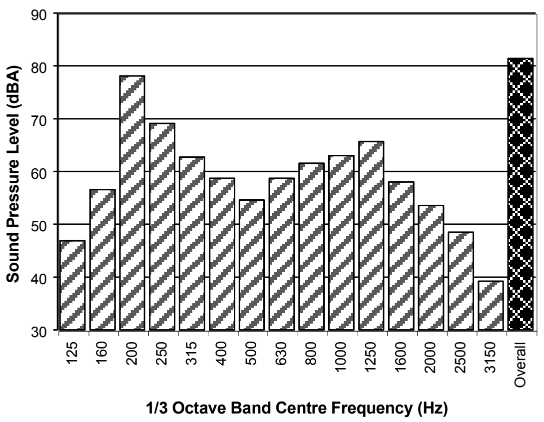
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.




## 8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log ($V/V_o$), where $V_o$ is the reference level ($10^{-9}$ m/s). Care is required in this regard, as other reference levels may be used by some organizations.

## 9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

## 10 Over-Pressure

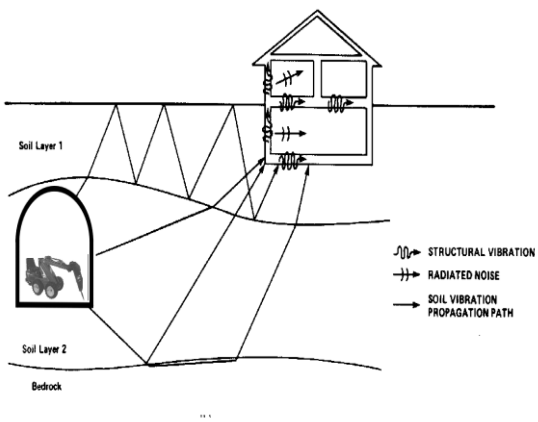
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

## 11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.




The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

# Appendix B

NML Exceedances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N

50 0 50 100 150 200 250 300 m

**Construction Noise Sources**

Ausgrid Site Works

**Exceedance of Daytime NMLs**

- NML Exceed <5 dBA
- NML Exceed 5 to 10 dBA
- NML Exceed 10 to 15 dBA
- NML Exceed 15 to 20 dBA
- NMI Exceed 20 to 25 dBA
- NML Exceed > 25 dBA

Sydney Motorway Corporation

WESTCONNEX - M4 EAST

**Ausgrid Site Compound**
**Maximum LAeq 15 min**
**Standard Daytime Constrution Period**

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# Appendix E

Flooding and drainage assessment of design changes

WestConnex

# Roads and Maritime Services

WestConnex M4 East

Flooding assessment of design changes

December 2015

**Prepared for**

Roads and Maritime Services

**Prepared by**

*Lyall and Associates*

# Document controls

| Title | Project title<br>Document type |
|---|---|
| V1 Rev 1 | |
| **Approval and authorisation** | |
| Prepared by: | Ben Noble |
| Authorised by, AECOM Australia Pty Limited: | Jay Stricker<br>Industry Director - Transport |
| Signed: |  |
| Date | 7/12/15 |

| Location | File name |
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| AECOM project folder | M4 East_PIR_FW_Flooding_001_20151207 |

| Document status | Date |
|---|---|
| FINAL | 7/12/15 |

# Contents

# Glossary of terms and abbreviations

| Term | Meaning |
|---|---|
| Afflux | Increase in water level resulting from a change in conditions. The change may relate to the watercourse, floodplain, flow rate, tailwater level etc. |
| AEP | Annual Exceedance Probability.<br>The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 $m^3/s$ has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 $m^3/s$ or larger events occurring in any one year (see also average recurrence interval). |
| ALS | Airborne Laser Scanning.<br>A type of aerial survey used to measure the elevation of the ground surface. |
| AHD | Australian Height Datum.<br>A common national surface level datum approximately corresponding to mean sea level. |
| ARI | Average Recurrence Interval.<br>The average period in years between the occurrence of a flood of a particular magnitude or greater. In a long period of say 1,000 years, a flood equivalent to or greater than a 100 year ARI event would occur 10 times. The 100 year ARI flood has a 1% chance (i.e. a one-in-100 chance) of occurrence in any one year (see annual exceedance probability).<br>The frequency of floods is generally referred to in terms of their AEP or ARI. In this report the frequency of floods generated by runoff from the study catchments is referred to in terms of their ARI, for example the 100 year ARI flood. |
| ARR | Australian Rainfall and Runoff (Institute of Engineers Australia, 1998). |
| BoM | Bureau of Meteorology |
| Catchment | The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location. |
| DECC | Department of Environment and Climate Change (now OEH). |
| DECCW | Department of Environment, Climate Change and Water (formerly, DECC, but now OEH). |
| Discharge | The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second ($m^3/s$). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (e.g. metres per second [m/s]). |
| DP | Deposited Plan. |
| Emergency management | A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding. |
| Flash flooding | Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain. |

| Term | Meaning |
|---|---|
| Flood | Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami. |
| Flood fringe area | The remaining area of flood prone land after floodway and flood storage areas have been defined. |
| Flood mitigation standard | The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding. |
| Flood prone land | Land susceptible to flooding by the Probable Maximum Flood. Note that the flood prone land is synonymous with flood liable land. |
| Flood storage area | Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas. |
| Floodplain | Area of land which is subject to inundation by floods up to and including the probable maximum flood event (i.e. flood prone land). |
| Floodplain Risk Management Plan | A management plan developed in accordance with the principles and guidelines in the Floodplain Development Manual, 2005. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives. |
| Floodway area | Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels. |
| FPA | Flood Planning Area.<br>The area of land inundated at the Flood Planning Level. |
| FPL | Flood Planning Level.<br>A combination of flood level and freeboard selected for planning purposes, as determined in floodplain risk management studies and incorporated in floodplain risk management plans. |
| Flow Velocity | A measure of how fast water is moving (e.g. metres per second [m/s]). |
| Freeboard | A factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. It is usually expressed as the difference in height between the adopted Flood Planning Level and the peak height of the flood used to determine the flood planning level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as “greenhouse” and climate change. Freeboard is included in the Flood Planning Level. |

| Term | Meaning |
|---|---|
| GPT | Gross pollutant trap.<br>A device designed to capture pollutants in stormwater runoff prior to discharge into the receiving system. GPT's are typically designed to capture litter and debris but may also capture hydrocarbons, suspended sediments and particle bound pollutants such as nitrogen, phosphorus and heavy metals. |
| GSDM | Generalised Short Duration Method.<br>A method for estimating the Probable Maximum Precipitation for catchments up to 1,000 $km^2$ in area. |
| HHWSS | Highest High Water Solstice Spring.<br>The tide level reached on average once or twice per year. |
| Hazard | A source of potential harm or a situation with a potential to cause loss. In relation to the NSW Floodplain Development Manual (2005) the hazard is flooding which has the potential to cause damage to the community. |
| Headwater | The upper reaches of a drainage system. |
| Hydraulics | The term given to the study of water flow in waterways, in particular the evaluation of flow parameters such as water level and velocity |
| Hydrograph | A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood. |
| Hydrology | The term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods. |
| Hyetograph | A graph which shows how rainfall intensities or depths vary with time during a storm burst. A design hyetograph shows the distribution of rainfall over a design storm burst. |
| Local Drainage | Land on an overland flow path where the depth of inundation during the 100 year ARI storm event is less than 150 millimetres. |
| Main Stream Flooding (MSF) | Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam. |
| Major Overland Flow (MOF) | Land on an overland flow path where the depth of inundation during a 100 year ARI storm event is equal to or greater than 150 millimetres. |
| Mainstream flooding | Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam. |
| Mathematical/computer models | The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain. |
| Merit approach | The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well-being of the State's rivers and floodplains |
| OEH | Office of Environment and Heritage (formerly DECCW) |
| Overland flooding | Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam. |
| Peak discharge | The maximum discharge occurring during a flood event. |
| Peak flood level | The maximum water level occurring during a flood event. |

| Term | Meaning |
|---|---|
| PMF | Probable Maximum Flood.<br>The flood that occurs as a result of the Probable Maximum Precipitation (PMP) on a study catchment. The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land (i.e. the floodplain). |
| PMP | Probable Maximum Precipitation.<br>The PMP is the result of the optimum combination of the available moisture in the atmosphere and the efficiency of the storm mechanism as regards rainfall production. The PMP is used to estimate PMF discharges using a catchment hydrologic model which simulates the conversion of rainfall to runoff. |
| PRM | Probabilistic Rational Method |
| Probability | A statistical measure of the expected chance of flooding (see annual exceedance probability). |
| RCBC | Reinforced Concrete Box Culvert |
| RCP | Reinforced Concrete Pipe |
| Risk | Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment. |
| RL | Reduced Level |
| Roads and Maritime | NSW Roads and Maritime Services |
| Runoff | The amount of rainfall which actually ends up as stream flow, also known as rainfall excess. |
| Stage | Equivalent to water level (both measured with reference to a specified datum) |
| SMC | Sydney Motorways Corporation |
| SW | Sydney Water |
| Tonkin Pipe | An oviform shaped pipe that was a common form of construction in many parts of Sydney in the 1930's. |
| Water surface profile | A graph showing the flood stage at any given location along a watercourse at a particular time. |
| WDA | WestConnex Delivery Authority |

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# Executive summary

## Overview

Lyall and Associates were commissioned on behalf of the NSW Roads and Maritime Services (Roads and Maritime) to undertake an investigation into the flooding and drainage issues associated with the construction and operation of the M4 East project (project). The findings of the investigation were presented in the report titled WestConnex M4 East EIS Surface Water: Flooding and Drainage (L&A, 2015), which was prepared to support the EIS for the project and is contained in Appendix Q of the EIS.

Subsequently, further work has been undertaken to develop the concept design presented in the EIS. This design development has included the following alternative design arrangements:

- An increase in the construction footprint at the Homebush Bay Drive civil site (C1) to the north to include a portion of land owned by Ausgrid (Homebush Bay Drive civil site (C1) expansion)
- Re-configuration of the ramps and connections between the M4 and the M4 East at the Homebush Bay Drive interchange (Homebush Bay Drive Interchange)
- Modification of the Wattle Street interchange to combine the dive and cut and cover structures for both the M4 East ramps and the M4-M5 Link ramps (Wattle Street (City West Link) interchange).

**Figure S1** shows the location of the three alternative design arrangements. **Tables S1**, **S2** and **S3** over page provide a summary of the works associated with the Homebush Bay Drive civil site (C1) expansion, Homebush Bay Drive Interchange and Wattle Street (City West Link) interchange, respectively.

This report presents the findings of an assessment of the flood related impacts associated with the alternative design arrangements listed above.

## Assessment of flood behaviour

The TUFLOW hydraulic models developed as part of L&A, 2015 for the purpose of assessing the flood related impacts of the concept design for the EIS were used as the basis for the current investigation.

For the purpose of identifying additional impacts and mitigation requirements associated with the alternative design arrangements, construction related flood impacts of the Homebush Bay Drive civil site (C1) expansion were assessed for the 100 year Average Recurrence Interval (ARI) event, while post-construction related impacts of the Homebush Bay Drive interchange and Wattle Street (City West Link) interchange were assessed for the 100 year ARI and Probable Maximum Flood (PMF) events.

## Summary of impacts and management requirements

**Tables S1**, **S2** and **S3** over page summarise the peak flood levels and flood related impacts of the alternative design arrangements at the Homebush Bay Drive civil site (C1) expansion, Homebush Bay Drive interchange and the Wattle Street (City West Link) interchange, respectively. Additional flood management measures beyond those presented in the EIS to manage the flood risk to the project and impacts on adjacent development are also outlined in **Tables S1**, **S2** and **S3**.

The findings of the assessment presented in **Tables S1**, **S2** and **S3** show that:

- The proposed construction activities within the additional construction footprint at Homebush Bay Drive civil site (C1) expansion would result in no significant change to the flood risk to the project or impacts on adjacent development in comparison to the assessment presented in the EIS. As a result, no further management measures would be required
- The proposed reconfiguration of ramps and connections between the M4 and the M4 East at the Homebush Bay Drive interchange would result in peak 100 year ARI flood levels and impacts upstream of Saleyards Creek bridges that are largely consistent with the EIS

- The changes to the arrangement at Homebush Bay Drive interchange would result in an increase in PMF levels upstream of the Saleyards Creek bridges, to a maximum of 0.4 metres (refer **Figure 4.5**), which is 0.1 metres higher than the PMF level identified in the EIS under post-construction conditions. However, the relative increase in the depth and extent of flooding is minor and no additional properties would be affected when compared to the post-construction impacts presented in the EIS. As a result, no additional management measures would be required
- The proposed changes to the location of the tunnel structures at the Wattle Street interchange, which include adjustments in road elevations along Wattle Street, would result in an increase in 100 year ARI flood levels by a maximum of 0.08 metres in properties that lie south of Wattle Street and east of Martin Street (refer **Figure 4.7**). In comparison, the concept design assessed for the EIS resulted in no increase in flood levels within these properties during a 100 year ARI flood
- An initial assessment undertaken as part of the present investigation shows that it would be feasible to offset the aforementioned impacts associated with the Wattle Street interchange by increasing the size of the cross drainage structures across Wattle Street between Martin Street and Waratah Street. **Figure 4.10** shows the key features of the assessed flood mitigation scheme, while **Figure 4.11** shows the impact the project in combination with the assessed measures would have on 100 year ARI flooding patterns. Further design development would be required during detailed design to confirm utility clashes and integration with the final road design. This would also provide an opportunity to refine the number, size and shape of the new culvert crossings
- The changes to the arrangement at Wattle Street interchange would result in peak PMF levels and impacts that are largely consistent with the EIS.
- Changes in drainage impacts would not be significantly different to the preferred design assessed in the EIS.

**Table S1 Summary of flood related impacts and management requirements – Homebush Bay Drive civil site (C1) expansion**

| Location [Design Option] | Stage | Catchment (Cross Drainage Identifier) [(1)] | Peak Flood Level (m AHD)[(2)] 100 year ARI | Peak Flood Level (m AHD)[(2)] PMF | Description of Alternative Design Arrangement | Flood Impacts | Potential Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| Homebush Bay Drive civil site (C1) expansion | Construction | Saleyards Creek (XD01a) | 3.3 | 4.4 | • Figure 4.1 shows the proposed expansion of the construction footprint at the Homebush Bay Drive civil site (C1) to the north, beyond that shown in the EIS.<br>• The additional site area for the Homebush Bay Drive civil site (C1) expansion would allow for:<br>– Utilisation of existing car parking spaces for around 300 light vehicles<br>– Reconfiguration of site office and amenities within the additional construction footprint.<br>• There would be no change to the type of facilities and activities within the Homebush Bay Drive civil site (C1) described in the EIS. However, the additional site area would allow for reconfiguration of facilities within the overall site. | • Figure 4.1 shows the extent to which floods of varying recurrence interval affect the Homebush Bay Drive civil site (C1) expansion, including the additional site area to the north.<br>• Should a 100 year ARI event occur during the construction phase of the project, then floodwater that surcharges the main arm of Saleyards Creek would extend into the additional site area over a width of about 2 to 14 metres along its eastern boundary and reach a maximum depth of about 0.6 metres.<br>• The proposed construction activities and facilities within the additional site area would be located outside the 100 year ARI extent. As a result, no additional flood risks at the Homebush Bay Drive civil site (C1) expansion are anticipated beyond those described in the EIS. Similarly, no additional impacts on mainstream flooding or major overland flow are anticipated during a 100 year ARI event. | • No additional management measures are required beyond those documented in the EIS. |

1. Refer **Figure S1** for location of Cross Drainage Identifier. Further details of the catchment draining to this location are provided in Chapter 4 of Appendix Q of the EIS.
2. Peak flood levels are based on an assessment of the concept designs provided by SMC of the alternative design arrangements and would be subject to further hydrologic/hydraulic assessment during development of the detailed design.

**Table S2 Summary of flood related impacts and management requirements – Homebush Bay Drive interchange**

| Location [Design Option] | Stage | Catchment (Cross Drainage Identifier) (1) | Peak Flood Level (m AHD)(2) 100 year ARI | Peak Flood Level (m AHD)(2) PMF | Description of the Alternative Design Arrangement | Flood Impacts | Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| Homebush Bay Drive interchange | Operational | Saleyards Creek (XD01a) | 3.6 | 4.6 | • **Figure 4.2** shows the proposed reconfiguration of ramps and connections between the M4 and M4 East at the Homebush Bay Drive interchange under the alternative design arrangement.<br>• Two new 16 m span plank bridge structures would be provided across Saleyards Creek upstream of the existing M4 to accommodate the westbound ramp and westbound entry ramps from the M4 West (refer **Bridges 1** and **2** on **Figure 4.2**). In comparison, the concept design assessed for the EIS contained a single 17 metre span bridge. However, the upstream extent of the two 16 metre span bridges is the same as that assessed for the EIS. | • **Figure 4.2** shows 100 year ARI flooding patterns under the alternative design arrangement. **Figure 4.3** shows flooding impacts of the alternative design arrangement in terms of the difference in peak 100 year ARI flood levels between present day and post-construction conditions (presented on **Figure 4.3** as “afflux”). Corresponding flooding patterns and impacts during a PMF event are shown on **Figures 4.4 and 4.5**.<br>• From inspection of **Figure 4.2**, there would be a minor reduction in peak 100 year ARI flood levels upstream of the Saleyards Creek bridges of 0.02 metres or less, which is largely consistent with the post-construction impacts presented in the EIS. Similarly, the peak 100 year ARI flood upstream of Bridge 1 is consistent with the EIS. | No additional management measures are required beyond those documented in the EIS. |

| Location [Design Option] | Stage | Catchment (Cross Drainage Identifier) (1) | Peak Flood Level (m AHD)(2) 100 year ARI | PMF | Description of the Alternative Design Arrangement | Flood Impacts | Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| | | | | | • The existing 9.4 metre span bridge at the M4 would be replaced with a series of 14 metre span plank bridge structures to accommodate the eastbound and westbound mainlines, ramps and connections (refer **Bridges 3** to **6** on **Figure 4.2**). In comparison, the concept design assessed for the EIS contained a series of 13 metre span plank bridge structures to replace the existing bridge.<br>• The reconfiguration of ramps and connections at the Homebush Bay Drive interchange would require adjustments to road elevations and wall heights in comparison to the concept design assessed in the EIS. | • **Figure 4.5** shows that there would be an increase in PMF levels upstream of the project corridor, to a maximum of 0.4 metres. This is 0.1 metres higher than the PMF level identified in the EIS under post-construction conditions and is due to the increase in elevation of the barrier wall along the southern side of the project corridor under the alternative design arrangement. However, the relative increase in the depth and extent of flooding is minor and no additional properties would be affected in comparison to the post-construction impacts presented in the EIS. | |

1. Refer **Figure S1** for location of Cross Drainage Identifier. Further details of the catchment draining to this location are provided in Chapter 4 of L&A, 2015.
2. Peak flood levels are based on an assessment of the concept designs provided by SMC of the alternative design arrangements and would be subject to further hydrologic/hydraulic assessment during development of the detailed design.

**Table 3 Summary of flood related impacts and management requirements – Wattle Street (City West Link) interchange**

| Location [Design Option] | Stage | Catchment (Cross Drainage Structure Identifier) [(1)] | Peak Flood Level (m AHD)(2) 100 year ARI | Peak Flood Level (m AHD)(2) PMF | Description of the Alternative Design Arrangement | Flood Impacts | Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| Wattle Street (City West Link) interchange | Operational | Iron Cove Creek (XD11) | 2.9 | 4.1 | • **Figure 4.6** shows the proposed reconfiguration of the Wattle Street interchange under the alternative design arrangement.<br>• The tunnel dive structure for the M4 East tunnel exit to Wattle Street would be moved slightly south and shortened. The tunnel dive structure for the M4 East tunnel entry would be relocated further to the east so that the tunnel entry ramp would be the eastern most (kerbside) lane.<br>• The reconfiguration of the tunnel dive structures would require adjustments to road elevations along Wattle Street, including tunnel entry and exit ramps, when compared to the concept design assessed in the EIS. | • **Figure 4.6** shows 100 year ARI flooding patterns under the alternative design arrangement. **Figure 4.7** shows flooding impacts of the alternative design arrangement in terms of the difference in peak 100 year ARI flood levels between present day and post-construction conditions (presented on **Figure 4.7** as “afflux”). Corresponding flooding patterns and impacts during a PMF event are shown on **Figures 4.8** and **4.9**. | • The impact of the alternative design arrangement on flooding conditions in existing development south of Wattle Street could be mitigated by increasing the size of the proposed cross drainage structures across Wattle Street, between Martin Street and Waratah Street. The layout of a potential flood mitigation scheme is shown on **Figure 4.10**. The scheme would involve augmentation of the existing cross drainage structure at XD11 with 3 off 1050 millimetre diameter and 2 off 750 millimetre diameter pipe culverts. An inlet structure measuring 6.3 metres long and 1.2 metres wide would also be required to capture overland flow and discharge it to the 3 off 1050 millimetre diameter pipe culverts. |

| Location [Design Option] | Stage | Catchment (Cross Drainage Structure Identifier) (1) | Peak Flood Level (m AHD)(2) 100 year ARI | PMF | Description of the Alternative Design Arrangement | Flood Impacts | Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| | | | | | | • From inspection of **Figure 4.7**, there would be an increase in peak 100 year ARI flood levels in existing residential development located to the south (upstream) of Wattle Street and east of Martin Street. This is due to the raised level of the tunnel entry ramp immediately east of Martin Street under the alternative arrangement which obstructs overland flow that discharges in a northerly direction across the low point in Wattle Street.<br>• Peak 100 year ARI flood levels within properties that lie south of Wattle Street would be increased by a maximum of 0.08 metres. In comparison, the concept design assessed for the EIS resulted in no increase in 100 year ARI flood levels in this area. | • **Figure 4.11** shows that implementation of the aforementioned scheme would mitigate the impacts of the project on flooding behaviour in existing residential development located to the south (upstream) of Wattle Street.<br>• Further design development would be required during detailed design to confirm utility clashes and integration with the final road design, which would also provide an opportunity to refine the number, size and shape of the new culvert crossings. |

| Location [Design Option] | Stage | Catchment (Cross Drainage Structure Identifier) (1) | Peak Flood Level (m AHD)(2) 100 year ARI | PMF | Description of the Alternative Design Arrangement | Flood Impacts | Management Measures / Further Investigations |
|---|---|---|---|---|---|---|---|
| | | | | | | • While floor level survey would be required to confirm whether the proposed works would increase flood damages in the affected properties, it is likely that flood management measures would be required to offset adverse impacts on properties that lie south of Wattle Street.<br>• **Figure 4.9** shows that there would be a localised increase in PMF levels in the vicinity of Loudon Avenue, by a maximum of 0.2 metres, which is slightly less than the corresponding impact of the concept design assessed for the EIS. | |

1. Refer **Figure S1** for location of Cross Drainage Identifier. Further details of the catchment draining to this location are provided in Chapter 4 of L&A, 2015.
2. Peak flood levels are based on an assessment of the concept designs provided by SMC of the alternative design arrangements and would be subject to further hydrologic/hydraulic assessment during development of the detailed design.

# 1 Introduction

## 1.1 Overview of the project

Sydney Motorway Corporation (SMC), on behalf of the NSW Roads and Maritime Services (Roads and Maritime), is seeking approval to upgrade and extend the M4 Motorway from Homebush Bay Drive at Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield, in inner western Sydney. These proposed works are described as the M4 East project (the project).

Approval is being sought under Part 5.1 of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act). The project was declared by the Minister for Planning to be State significant infrastructure and critical State significant infrastructure and an environmental impact statement (EIS) was therefore required.

An EIS was prepared for the project and was submitted in September 2015. The EIS and the associated specialist studies were then placed on public exhibition for a 55 day period, during which time the community and stakeholders were invited to make comments on the project and the EIS.

The project is a component of WestConnex, which is a proposal to provide a 33 kilometre motorway linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct. The location of WestConnex is shown in **Figure 1.1**. The individual components of WestConnex are:

- M4 Widening – Pitt Street at Parramatta to Homebush Bay Drive (planning approval granted and under construction)
- M4 East (the subject of this report)
- New M5 – King Georges Road at Beverly Hills to St Peters (EIS currently on public display)
- King Georges Road Interchange Upgrade (planning approval granted)
- M4–M5 Link – Haberfield to St Peters, including the Southern Gateway and Southern Extension (undergoing concept development).


**Figure 1.1** **WestConnex**

Separate planning applications will be lodged for each individual component project. Each project will be assessed separately, but the impacts of each project will also be considered in the context of the wider WestConnex.

The NSW Government initially established the WestConnex Delivery Authority (WDA) to deliver WestConnex. WDA was established as an independent public subsidiary corporation of Roads and Maritime and was project managing the planning approval process for the project on its behalf.

Since June 2015, the project delivery functions of WDA have been under transfer to SMC, following a decision to evolve WestConnex governance into a single decision-making entity. The transfer of functions was completed on 30 September 2015.

SMC is a private corporation established under the Corporations Act 2001 (Commonwealth) with a majority independent board of nine directors. The NSW Roads Minister and NSW Treasurer are joint shareholders. It is a public financial enterprise established by regulation.

Notwithstanding this, for the purpose of the planning application for the M4 East project, Roads and Maritime is the proponent.

## 1.2 Project location

The project is located in the inner west region of Sydney within the Auburn, Strathfield, Canada Bay, Burwood and Ashfield local government areas (LGAs). The project travels through 10 suburbs: Sydney Olympic Park, Homebush West, Homebush, North Strathfield, Strathfield, Concord, Burwood, Croydon, Ashfield and Haberfield. The location of the project is shown in **Figure 1.2**.

The project is generally located within the M4 and Parramatta Road corridor, which links Broadway at the southern end of the Sydney central business district (CBD) and Parramatta in Sydney's west, about 20 kilometres to the west of the Sydney CBD. This corridor also provides the key link between the Sydney CBD and areas further west of Parramatta (such as Penrith and western NSW).

The western end of the project is located at the interchange between Homebush Bay Drive and the M4, about 13 kilometres west of the Sydney CBD. The project at this location would tie in with the M4 Widening project in the vicinity of Homebush Bay Drive. The tunnels which form part of the project would dive from the centre of the M4, west of the existing pedestrian footbridge over the M4 at Pomeroy Street, and would continue under the northern side of the existing M4 and Parramatta Road, before crossing beneath Parramatta Road at Broughton Street, Burwood. The tunnels would under the southern side of Parramatta Road until the intersection of Parramatta Road and Wattle Street at Haberfield. Ramps would connect the tunnels to Parramatta Road and Wattle Street (City West Link) at the eastern end of the project. The tunnels would end in a stub connection to the possible future M4–M5 Link (which is subject to planning approval), near Alt Street.

The project would include interchanges between the tunnels and the above ground road network, along with other surface road works, at the following locations:

- M4 and Homebush Bay Drive interchange at Sydney Olympic Park and Homebush
- Powells Creek, near George Street at North Strathfield
- Queen Street, near Parramatta Road at North Strathfield
- M4 and Sydney Street, Concord Road and Parramatta Road interchange at North Strathfield
- Wattle Street (City West Link), between Parramatta Road and Waratah Street at Haberfield
- Parramatta Road, between Bland Street and Orpington Street at Ashfield and Haberfield.

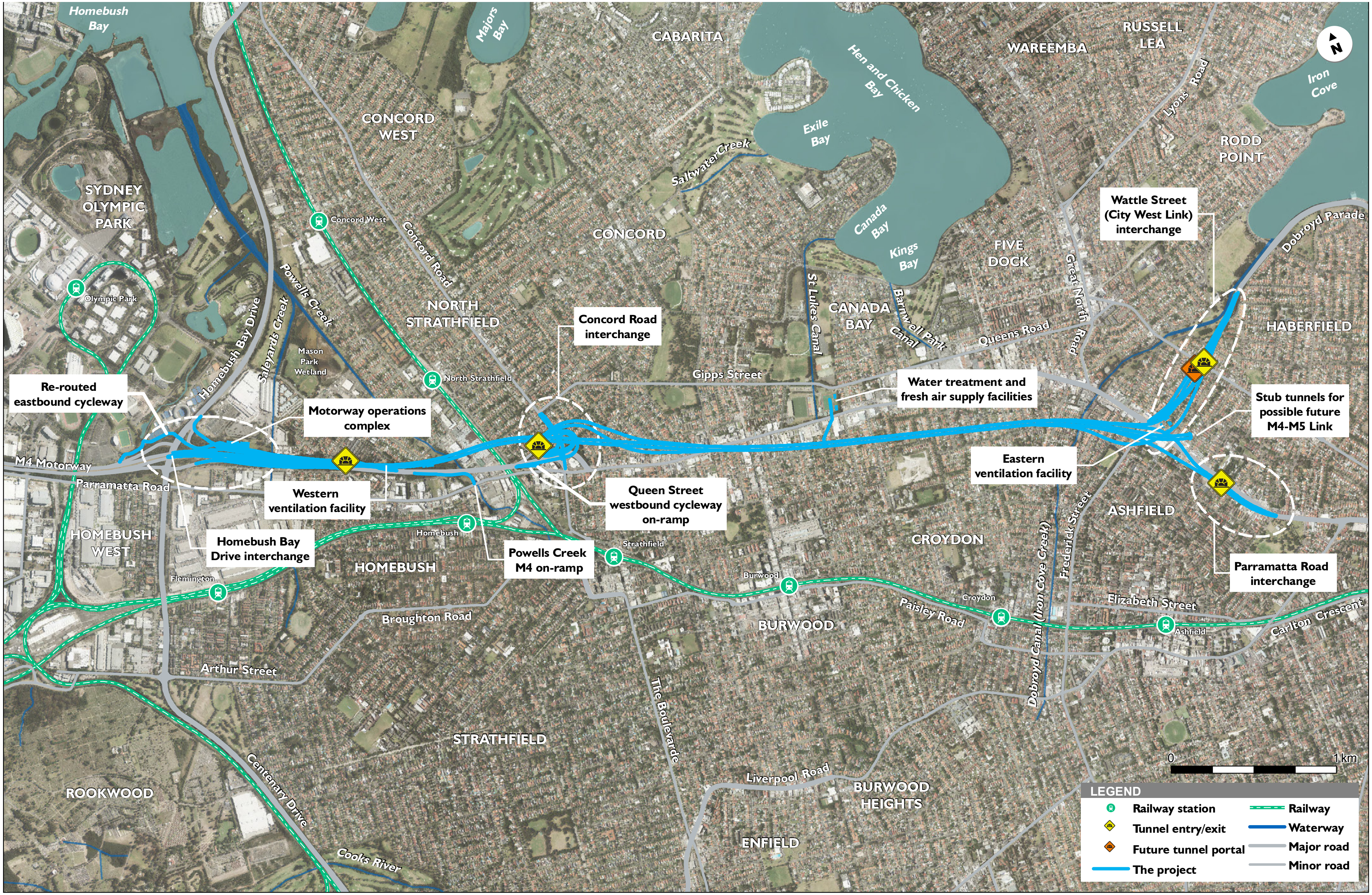


**Figure 1.2 Project location**

## 1.3 Purpose of this report

This report has been prepared to outline and assess the impact of alternative design options that have been identified since the exhibition of the EIS. As outlined in section 5.1 of the EIS, the project description was based on the preliminary concept design and will be refined during detailed design. The EIS notes that the final design of the M4 East project that is built could therefore vary from its description in the EIS.

This report assesses the flooding related impacts of the alternative design options, as described in **Chapter 2** of this report (proposed design changes).

## 1.4 Assessment methodology

The TUFLOW hydraulic models developed for the purpose of assessing the flood related impacts of the concept design for the EIS were used as the basis for the current investigation. Further details on the development of these models are presented in Appendix Q of the EIS. Changes that have been made to the structure of the TUFLOW hydraulic models as part of the present assessment of the alternative design options are summarised in Chapter 4 (assessment of impacts) of this report.

For the purpose of identifying additional impacts and management requirements associated with the alternative design options, construction related flood impacts of the Homebush Bay Drive civil site (C1) expansion were assessed for the 100 year Average Recurrence Interval (ARI) event, while post-construction related impacts of the Homebush Bay Drive interchange and Wattle Street (City West Link) interchange were assessed for the 100 year ARI and Probable Maximum Flood (PMF) events.

# 2 Proposed design changes

## 2.1 Homebush Bay Drive civil site (C1) expansion

It is proposed to expand the construction footprint at the Homebush Bay Drive civil site (C1) to the north, beyond that shown in Figure 5.29 on page 5-58 of the EIS. The affected land is owned by Ausgrid and is currently used for the following:

- Transmission line easement to the Mason Park Substation
- Hardstand car park area which is currently disused but has been previously used by the adjacent Direct Factory Outlet as an overflow car park.

The change to the construction footprint is shown in Figure 2.1. This land (or part thereof) would be leased from Ausgrid for the duration of construction.

The expansion of the Homebush Bay Drive civil site (C1) would allow for:

- Utilisation of existing car parking spaces for around 300 light vehicles
- Reconfiguration of site office, amenities and workshop facilities
- Reorientation of sedimentation basin and relocation of mulch and topsoil stockpile.

The sedimentation basin and mulch and topsoil stockpile would remain within the original extent of the Homebush Bay Drive civil site (C1). The existing transmission line easement, below the high voltage transmission lines, would be an exclusion zone, with the exception of internal roads and a footpath to enable movements across the easement.

The expansion of the construction footprint would allow for changes to the layout of the Homebush Bay Drive civil site (C1), as shown in **Figure 2.1**.

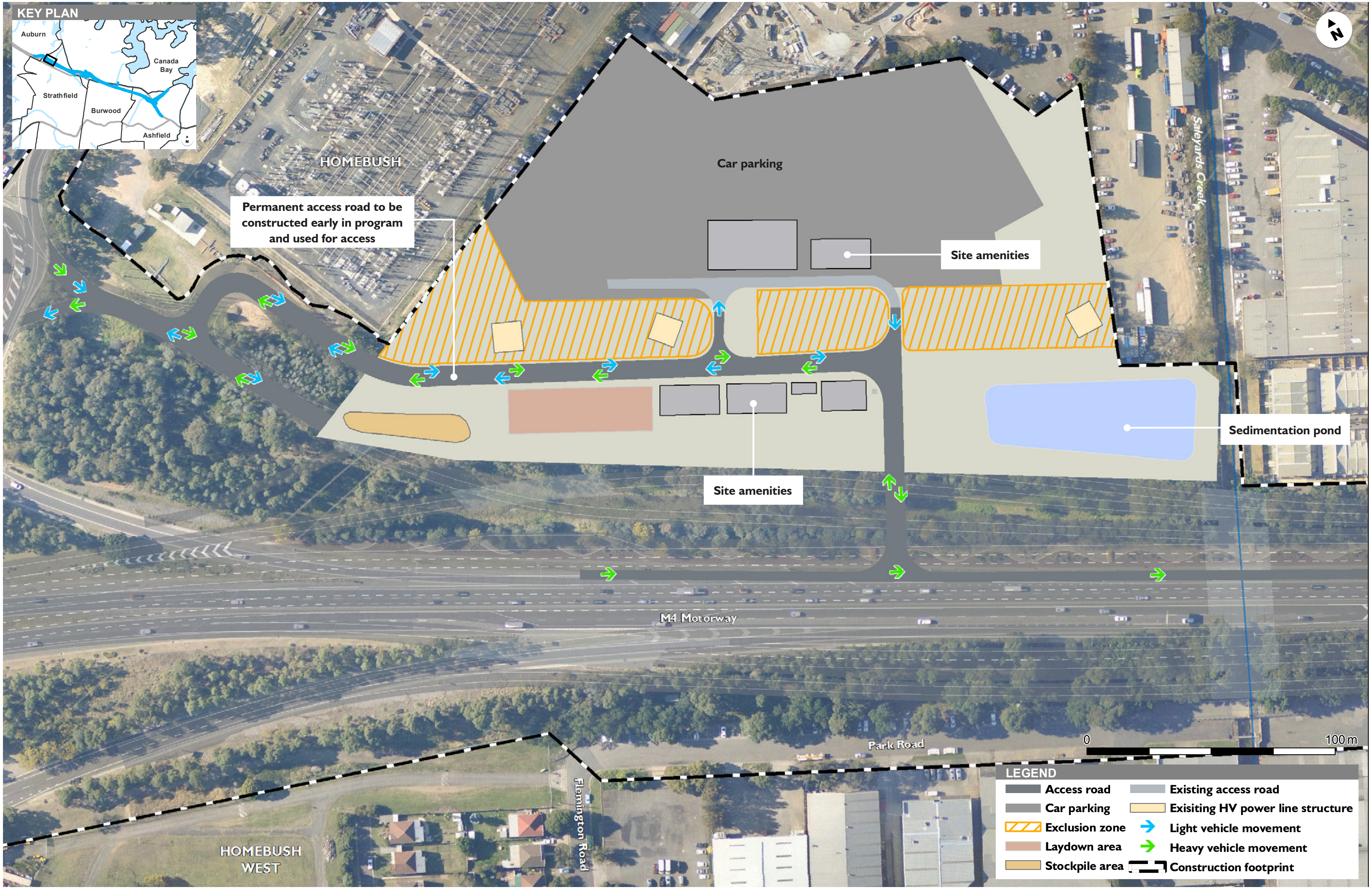


**Figure 2.1 Revised Homebush Bay Drive civil site (C1)**

## 2.2 Homebush Bay Drive interchange

In the EIS, the Homebush Bay Drive interchange included two major bridge structures near Saleyards Creek to carry surface M4 traffic over traffic entering and exiting the M4 East mainline tunnels. The layout of the traffic lanes could be considered counter-intuitive, with traffic lanes to and from the new mainline tunnels provided on the outside of traffic lanes to and from the surface M4. This arrangement had the potential for the layout of the on- and off-ramps to be confusing for motorists.

Eastbound motorists wanting to enter the tunnel would have needed to use the northern (kerbside) lane, whereas drivers wanting to access the existing M4 (to the north of the tunnel) would have needed to use the southern lane. Westbound motorists wanting to continue on the M4 would have needed to go up and over a bridge and then back down onto the motorway rather than driving straight through at-grade. The proposed change would resolve these issues.

To maintain eastbound access to the existing M4 from Homebush Bay Drive, the design described in the EIS incorporated the construction of an elevated bridge up to eight metres in height adjacent to apartments on Verley Drive. The interchange as described in the EIS is depicted in **Figure 2.2** as an oblique elevation.

As a result of ongoing design development, the configuration of ramps and connections between the M4 and M4 East at the Homebush Bay Drive interchange is proposed to be modified. The purpose of these changes is to reduce the size of bridge structures, follow more direct grade lines and provide a more intuitive alignment for drivers entering and exiting at the Homebush Bay Drive interchange. The reconfiguration would also reduce potential visual and noise impacts on residents of Verley Drive.

The below sections outline the proposed changes to the configuration of this interchange. The new arrangement is shown in **Figure 2.3** as an oblique elevation and **Figure 2.4** in plan view. An indicative view of the revised interchange is shown in **Figure 2.5**.

### M4 Motorway surface realignment

There would be no change to the western connection to the M4 Widening project as described in section 5.5.1 of the EIS. Traffic lanes on the M4 would continue to be realigned so that the dominant traffic flow would be to and from the new mainline tunnels.

In the eastbound direction, the lane for M4 surface traffic would be realigned to the north of the existing traffic lanes, and would travel under a short bridge structure carrying the M4 East entry ramp from Homebush Bay Drive. This short bridge structure would replace the long bridge structure further to the east as described in the EIS. The M4 surface traffic lane would widen to two lanes as it joins with a lane from the Homebush Bay Drive on-ramp for M4 surface traffic.

In the westbound direction, the two traffic lanes for M4 surface traffic would be realigned to the south of the existing traffic lanes. These lanes would continue at grade (instead of on a large bridge structure, as described in the EIS) before merging with the existing M4 to the east of Homebush Bay Drive.

### Homebush Bay Drive eastbound on-ramp

As described in the EIS, the existing eastbound on-ramp from Homebush Bay Drive to the M4 would be realigned to the north.

At Homebush Bay Drive, the on-ramp would consist of one traffic lane which would provide access to the eastbound mainline tunnel. A lane on the northern side would provide access to the surface M4 eastbound. Both lanes would include a small bridge structure over the proposed re-routed eastbound cycleway, which would travel through an underpass under the on-ramp (instead of on a bridge over the on-ramp, as described in the EIS).

Traffic from the Homebush Bay Drive on-ramp choosing to use the eastbound mainline tunnel would travel in the southern-most (inside) lane, over the cycleway underpass, then on the short bridge described above (over eastbound surface M4 traffic) to merge with traffic travelling from the existing M4 east of Saleyards Creek. The design of the on-ramp widens to two lanes for managed motorway storage, before tapering back to one lane prior to merging with traffic travelling from the existing M4.

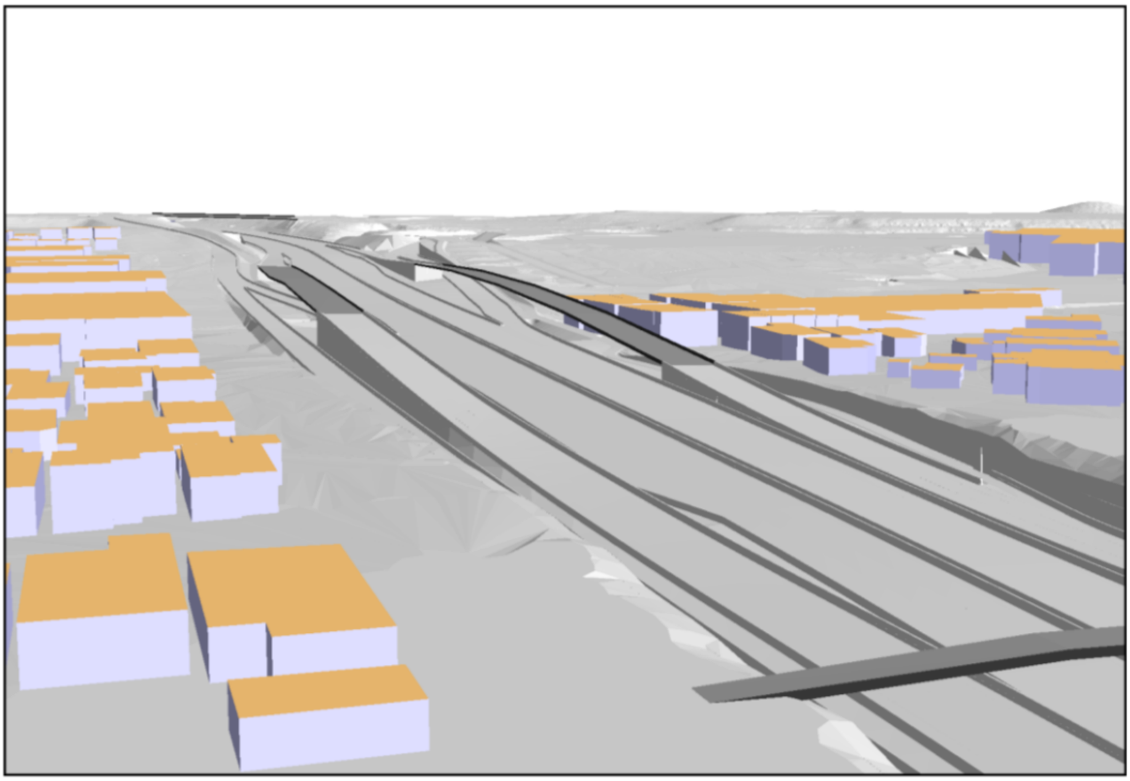

**Figure 2.2 EIS Homebush Bay Drive interchange (oblique elevation, facing west)**

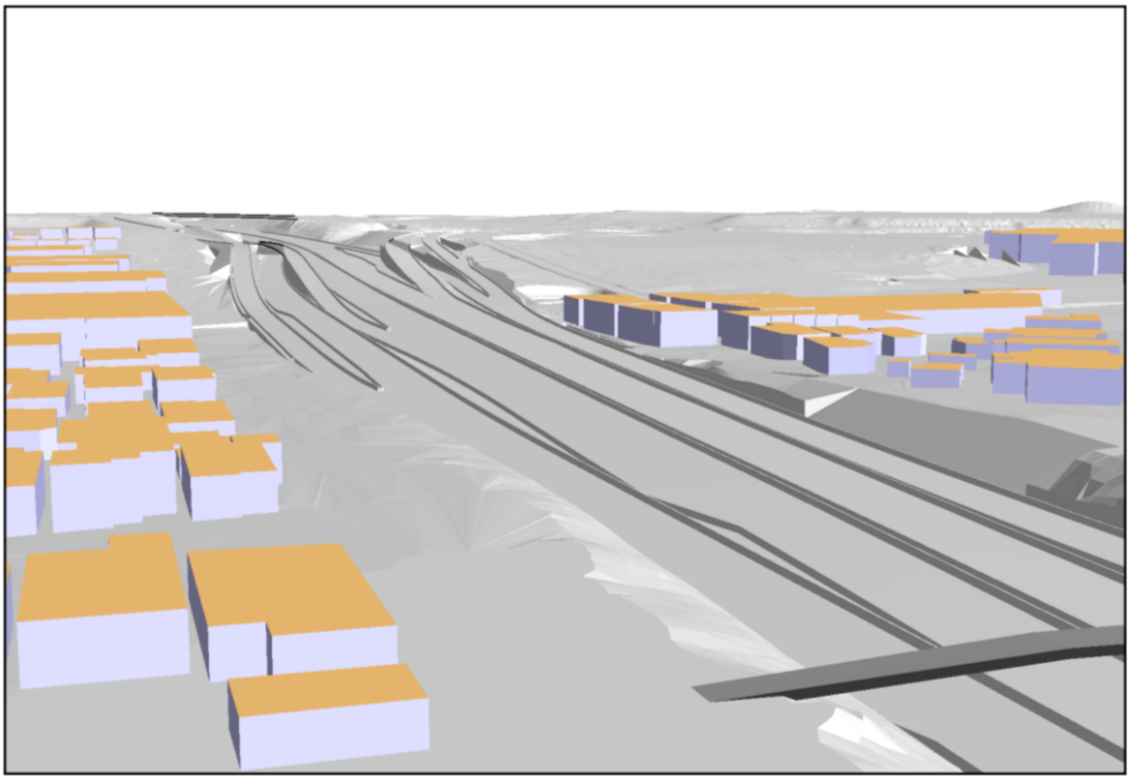

**Figure 2.3 Reconfigured Homebush Bay Drive interchange (oblique elevation, facing west)**


**Figure 2.4 Reconfigured Homebush Bay Drive interchange**

**Figure 2.5** **Indicative view of the revised Homebush Bay Drive interchange, looking east from Homebush Bay Drive. This image is conceptual and is included for illustration purposes only**

Traffic from the Homebush Bay Drive on-ramp choosing to use the surface M4 would travel in the northern-most (outside) lane, over the cycleway underpass. It would then join with the lane from the existing M4 described above, and would travel at grade before connecting to the existing M4 just west of Underwood Road.

### Homebush Bay Drive westbound off-ramp

The westbound off-ramp to Homebush Bay Drive would be realigned to the south and would diverge from the surface M4 just east of Derowie Avenue, which is further to the west than the EIS configuration.

Traffic coming out of the westbound mainline tunnel and choosing to exit at Homebush Bay Drive would use a new exit lane just west of Derowie Avenue, which would travel over Saleyards Creek and a second small bridge structure near Flemington Road, after which it would join the surface M4 to Homebush Bay Drive off-ramp. The two off-ramps would tie into the existing off-ramp about 250 metres east of the signalised intersection with Homebush Bay Drive.

### M4 East tunnel entrance and exit

There would be no changes to the M4 East tunnel entrance and exit portals and the M4 East surface configuration leading to the portals.

### Re-routed eastbound cycleway

The proposed re-routed cycleway would travel under the Homebush Bay Drive on-ramp via an underpass, rather than an overpass as described in the EIS. The off-road section of the re-routed eastbound cycleway has been shortened, and would connect back into the M4 shoulder on the eastbound Homebush Bay Drive on-ramp connection to the surface M4 about 150 metres east of the underpass. The cycleway underpass would be developed further during detailed design.

## 2.3 Wattle Street (City West Link) interchange

In the EIS, the Wattle Street (City West Link) interchange included separate cut and cover tunnel structures. The interchange as described in the EIS is depicted in **Figure 2.6** as an oblique elevation.

As a result of ongoing design development, the configuration of the Wattle Street interchange is proposed to be modified. The purpose of these changes is to combine the dive and cut and cover structures for both the M4 East ramps and the M4–M5 Link ramps.

The below sections outline the proposed changes to the configuration of the interchange. The new arrangement is shown in **Figure 2.7** as an oblique elevation and **Figure 2.8** in plan view. An indicative view of the revised interchange is shown in **Figure 2.9**. There would also be changes to subsurface property acquisition.

### M4 East tunnel exit to Wattle Street

The M4 East tunnel exit to Wattle Street would not be altered significantly. The tunnel portal would remain on the northern side of Ramsay Street.

The dedicated right turn bay at the Waratah Street signalised intersection would remain for traffic exiting the eastbound mainline tunnel only.

### M4 East tunnel entrance from Wattle Street

The M4 East tunnel entry from Wattle Street would be relocated further to the east, so that the on-ramp would be the eastern-most (kerbside) lane while the surface Wattle Street lanes would continue as the centre lanes. The dive structure for this on-ramp would start on the southern side of Martin Street. The tunnel portal would remain on the northern side of Ramsay Street.

There would be no other change to the on-ramp.

### Wattle Street surface adjustments

The surface Wattle Street eastbound lanes would not change as part of the modification of the interchange.

The surface Wattle Street westbound lanes would be realigned to the east of its existing alignment; however, it would continue in the centre lanes (instead of the kerbside lanes as described in the EIS). To do this, the surface lanes would travel over the cut and cover sections of the M4–M5 Link on- and off-ramps.

South of Ramsay Street, the westbound surface Wattle Street lanes would still split as described in the EIS, two separate sets of lanes providing access to Parramatta Road westbound, and Parramatta Road eastbound or Frederick Street southbound.

North of Waratah Street, the surface works would remain on the same general alignment.

### M4–M5 Link on- and off-ramps tunnels

The M4–M5 Link cut and cover structures would start in about the same location as described in the EIS, but would be realigned so that they are positioned between the M4 East on- and off-ramps. The on- ramp dive structure would be lengthened, while the off-ramp dive structure would be shortened.

### Martin Street intersection works

As a result of the realignment of the M4 East westbound tunnel entry from Wattle Street, the on-ramp would become the eastern-most (kerbside) lane, while the surface Wattle Street lanes would continue as the centre lanes. A cul-de-sac would therefore be established at Martin Street on the eastern side of Wattle Street. This reconfiguration would mean that no access to the Wattle Street lanes or the M4 East on-ramp would be provided from Martin Street to Wattle Street.

Alternative access to Wattle Street would be available via Alt Street and Ramsay Street/Waratah Street. As the on-ramp for the M4 East tunnel entrance from Wattle Street would start on the northern side of Martin Street, access to the M4 East tunnel entrance would be via the intersection of Waratah Street and Wattle Street.

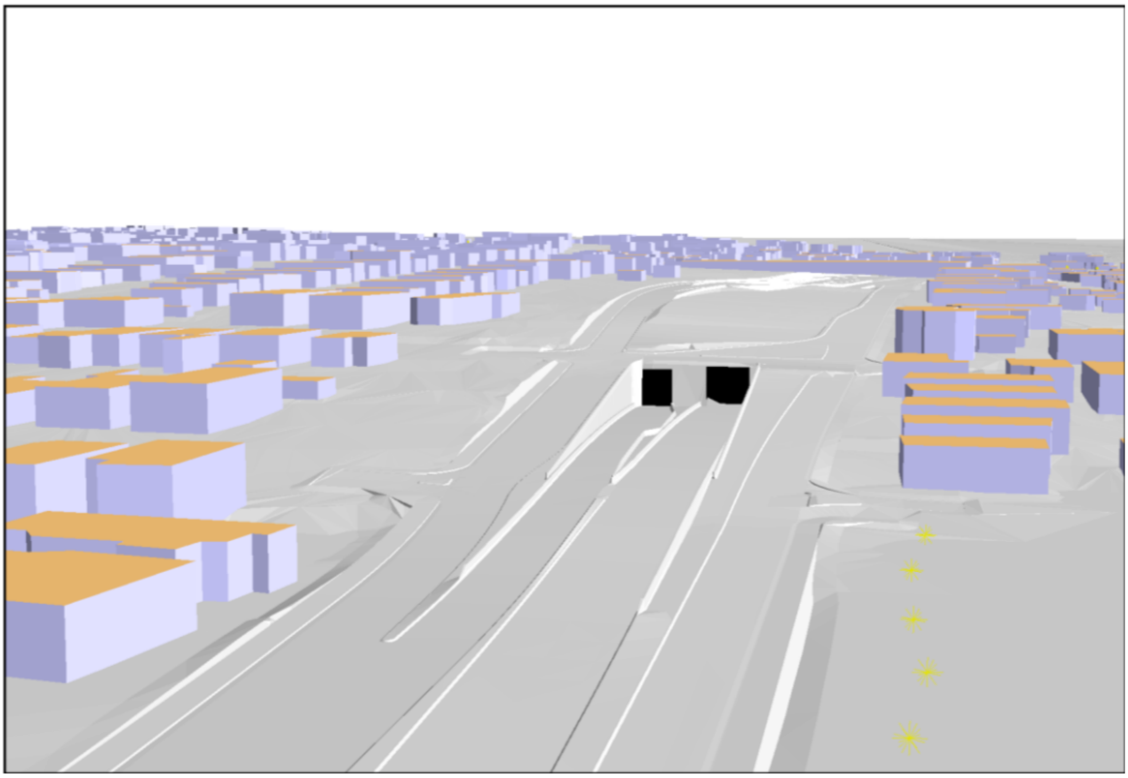

**Figure 2.6 EIS Wattle Street interchange (oblique elevation, facing south)**

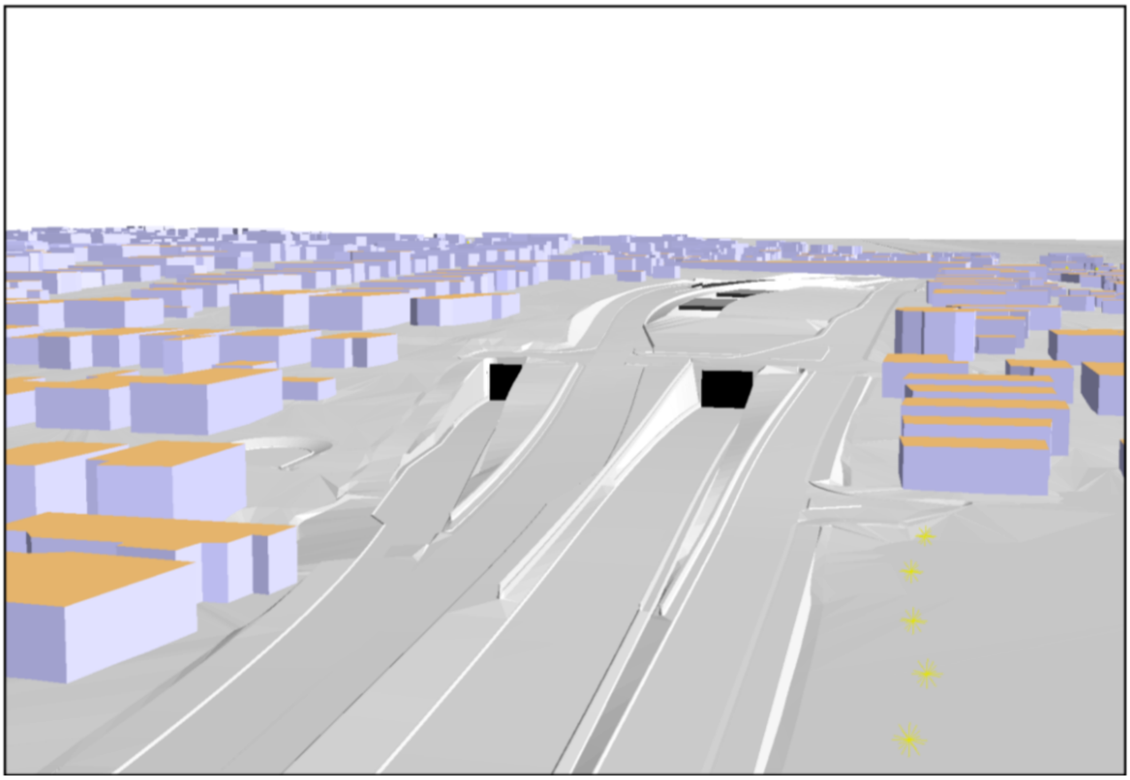

**Figure 2.7 Reconfigured Wattle Street interchange (oblique elevation, facing south)**


**Figure 2.8 Reconfigured Wattle Street (City West Link) interchange**

**Figure 2.9** **Indicative view of the revised Wattle Street interchange, looking south along Wattle Street from near Reg Coady Reserve. This image is conceptual and is included for illustration purposes only**

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# 3 Existing environment

The Homebush Bay civil site (C1) expansion and the Homebush Bay Drive interchange are located within the Saleyards Creek catchment, which is a tributary of Powells Creek. The Wattle Street (City West Link) interchange is located within the Dobroyd Canal (Iron Cove Creek) catchment. A description of the broader catchments, as well as existing flood behaviour in the vicinity of the three alternative design arrangements is presented in sections 4.4 and 4.5 of Appendix Q of the EIS.

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# 4 Assessment of impacts

## 4.1 Overview

This chapter provides an assessment of the additional flood risks and impacts associated with the alternative design arrangements.

The Homebush Bay Drive civil site (C1) expansion would be utilised for the construction of the M4 East project and would and has therefore been assessed for additional construction related risks and impacts.

The alternative design arrangements at Homebush Bay Drive interchange and Wattle Street interchange have been assessed for additional operational flood risks and impacts. The nature of these alternative design arrangements would pose no significant change in construction related risks and impacts to those assessed as part of the EIS and presented in Appendix Q of the EIS.

For the purpose of identifying additional impacts and management requirements associated with the alternative design arrangements, construction related flood impacts of the Homebush Bay Drive civil site (C1) were assessed for the 100 year Average Recurrence Interval (ARI) event, while post-construction related impacts of the Homebush Bay Drive interchange and Wattle Street (City West Link) interchange were assessed for the 100 year ARI and Probable Maximum Flood (PMF) events.

## 4.2 Homebush Bay Drive civil site (C1) expansion

The Powells Creek TUFLOW hydraulic model developed for the purpose of assessing the flood related impacts of the preferred design for the EIS was used as the basis for the current assessment of the revised compound layout. This model included the Saleyards Creek floodplain in the vicinity of the Homebush Bay Drive civil site (C1) expansion.

The proposed construction facilities and activities within the increased construction footprint of the Homebush Bay civil site (C1) are located outside the 100 year ARI flood extent. As a result, no changes were made to the structure of the Powells Creek TUFLOW Model to assess construction phase impacts on flood behaviour during a 100 year ARI event.

**Figure 4.1** shows the extent to which floods of varying recurrence interval affect the Homebush Bay Drive civil site (C1) expansion, including the additional site area to the north.

Should a 100 year ARI event occur during the construction phase of the project, then floodwater that surcharges the main arm of Saleyards Creek would extend into the additional site area over a width of about 2 to 14 metres along its eastern boundary and reach a maximum depth of about 0.6 metres.

The proposed construction activities and facilities within the additional site area would be located outside the 100 year ARI extent. As a result, no additional flood risks at the Homebush Bay Drive civil site (C1) are anticipated beyond those described in the EIS. Similarly, no additional impacts on mainstream flooding or major overland flow are anticipated during a 100 year ARI event.

## 4.3 Homebush Bay Drive interchange

The Powells Creek TUFLOW hydraulic model developed for the purpose of assessing the flood related impacts of the concept design for the EIS was used as the basis for the current assessment of the revised interchange design. This model included the Saleyards Creek floodplain in the vicinity of the Homebush Bay Drive interchange.

The following changes were made to the structure of the Powells Creek TUFLOW Model to reflect post-construction conditions of the alternative design arrangement:

- Grid elevations in the model were adjusted to reflect the changes in road elevations and barrier extents and heights associated with the alternative design arrangement
- The configuration of the Saleyards Creek bridges in the TUFLOW model developed for the EIS to represent post-construction conditions was reviewed and updated to reflect the changes in bridge layout under the alternative design arrangement. For the EIS, the modelled configuration of the

Saleyards Creek bridge was based on details provided in the TUFLOW model developed by Leighton Samsung John Holland as part of the M4 East preferred design.

**Figure 4.2** shows 100 year ARI flooding patterns under the alternative design arrangement. **Figure 4.3** shows flooding impacts of the alternative design arrangement in terms of the difference in peak 100 year ARI flood levels between present day and post-construction conditions (presented on **Figure 4.3** as “afflux”). Corresponding flooding patterns and impacts during a PMF event are shown on **Figures 4.4** and **4.5**.

From inspection of **Figure 4.2**, there would be a minor reduction in peak 100 year ARI flood levels upstream of the Saleyards Creek bridges of 0.02 metres or less, which is largely consistent with the post-construction impacts presented in the EIS. Similarly, the peak 100 year ARI flood upstream of Bridge 1 is consistent with the EIS.

**Figure 4.5** shows that there would be an increase in PMF levels upstream of the project corridor, to a maximum of 0.4 metres. This is 0.1 metres higher than the PMF level identified in the EIS under post-construction conditions and is due to the increase in elevation of the barrier wall along the southern side of the project corridor under the alternative design arrangement. However, the relative increase in the depth and extent of flooding is minor and no additional properties would be affected in comparison to the post-construction impacts presented in the EIS.

## 4.4 Wattle Street (City West Link) interchange

The Iron Cove Creek TUFLOW hydraulic model developed for the purpose of assessing the flood related impacts of the concept design for the EIS was used as the basis for the current assessment of the revised interchange design.

The following changes were made to the structure of the Iron Cove Creek TUFLOW Model to reflect post-construction conditions of the alternative design arrangement:

- Grid elevations in the model were adjusted to reflect the changes in road elevations, barrier extents and heights, as well as the location of tunnel dive structures associated with the alternative design arrangement
- The configuration of the pit and pipe drainage system in the TUFLOW model developed for the EIS to represent post-construction conditions was reviewed and adjustments made to the alignment of pits and pipes to suit the changes in kerb alignments under the alternative design arrangement.

**Figure 4.6** shows 100 year ARI flooding patterns under the alternative design arrangement. **Figure 4.7** shows flooding impacts of the alternative design arrangement in terms of the difference in peak 100 year ARI flood levels between present day and post-construction conditions (presented on **Figure 4.7** as “afflux”). Corresponding flooding patterns and impacts during a PMF event are shown on **Figures 4.8** and **4.9**.

From inspection of **Figure 4.7**, there would be an increase in peak 100 year ARI flood levels in existing residential development located to the south (upstream) of Wattle Street and east of Martin Street. This is due to the raised level of the tunnel entry ramp immediately east of Martin Street under the alternative arrangement which obstructs overland flow that discharges in a northerly direction across the low point in Wattle Street.

Peak 100 year ARI flood levels within properties that lie south of Wattle Street would be increased by a maximum of 0.08 metres. In comparison, the concept design assessed for the EIS resulted in no increase in 100 year ARI flood levels in this area.

While floor level survey would be required to confirm whether the proposed works would increase flood damages in the affected properties, it is likely that flood management measures would be required to offset adverse impacts on properties that lie south of Wattle Street.

**Figure 4.9** shows that there would be a localised increase in PMF levels in the vicinity of Loudon Avenue, by a maximum of 0.2 metres as compared to present day conditions, which is slightly less than the corresponding impact of the concept design assessed for the EIS.

The impact of the alternative design arrangement on flooding conditions in existing development south of Wattle Street could be mitigated by increasing the size of the proposed cross drainage structures across Wattle Street, between Martin Street and Waratah Street. The layout of a potential flood mitigation scheme is shown on **Figure 4.10**. The scheme would involve augmentation of the existing cross drainage structure at XD11 with 3 off 1050 millimetre diameter and 2 off 750 millimetre diameter pipe culverts. An inlet structure measuring 6.3 metres long and 1.2 metres wide would also be required to capture overland flow and discharge it to the 3 off 1050 millimetre diameter pipe culverts.

**Figure 4.11** shows that implementation of the aforementioned scheme would mitigate the impacts of the project on flooding behaviour in existing residential development located to the south (upstream) of Wattle Street.

The proposed mitigation described above outlines one possible way to mitigate the assessed impacts. Further development would be required during detailed design to confirm utility clashes and integration with the final road design, which would also provide an opportunity to refine the number, size and shape of the new culvert crossings.

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# 5 Additional management measures

**Table 5.1** sets out a recommended management measure to address the additional flood impacts associated with the alternative design arrangement at Wattle Street (City West Link) interchange.

The assessment of the alternative design arrangements at Homebush Bay civil site (C1) expansion and Homebush Bay Drive interchange has identified that there would be no significant change to the flood risks and impacts when compared to the concept design assessed in the EIS. **Table 5.1** outlines the proposed additional environmental management measures.

**Table 5.1 Additional environmental management measures**

| Impact | Environmental management measure | Responsibility | Timing |
|---|---|---|---|
| **Operation** | | | |
| | A new drainage structure near XD11 will be constructed to mitigate the impacts of flooding on existing residential development located to the east (upstream) of Wattle Street. | Construction contractor | Pre-construction |

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# 6 Conclusion

The present assessment found that the Homebush Bay civil site (C1) expansion and alternative design arrangement at Homebush Bay Drive interchange would result in no significant change to flood related risks and impacts when compared to the preferred design assessed in the EIS. As a result, no additional management measures are required at these locations beyond those presented in the EIS.

The proposed changes to the location of the tunnel structures at the Wattle Street (City West Link) interchange, which include adjustments in road elevations along Wattle Street, would result in an increase in 100 year ARI flood levels by a maximum of 0.08 metres in properties that lie south of Wattle Street and east of Martin Street. In comparison, the preferred design assessed for the EIS resulted in no increase in flood levels within these properties during a 100 year ARI flood.

An initial assessment undertaken as part of the present investigation has demonstrated that it would be feasible to offset the aforementioned impacts associated with the Wattle Street interchange by increasing the waterway of the cross drainage in Wattle Street between Martin Street and Waratah Street. **Figure 4.10** shows the key features of the assessed flood mitigation scheme, while **Figure 4.11** shows the impact the project in combination with the assessed measures would have on 100 year ARI flooding patterns. Further development would be required during detailed design to confirm utility clashes and integration with the final road design, which would also provide an opportunity to refine the number, size and shape of the new culvert crossings.

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# 7 References

Lyall and Associates, 2015. *WestConnex M4 East EIS Surface Water: Flooding and Drainage.*

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# Appendix A

## Flood impact assessment figures

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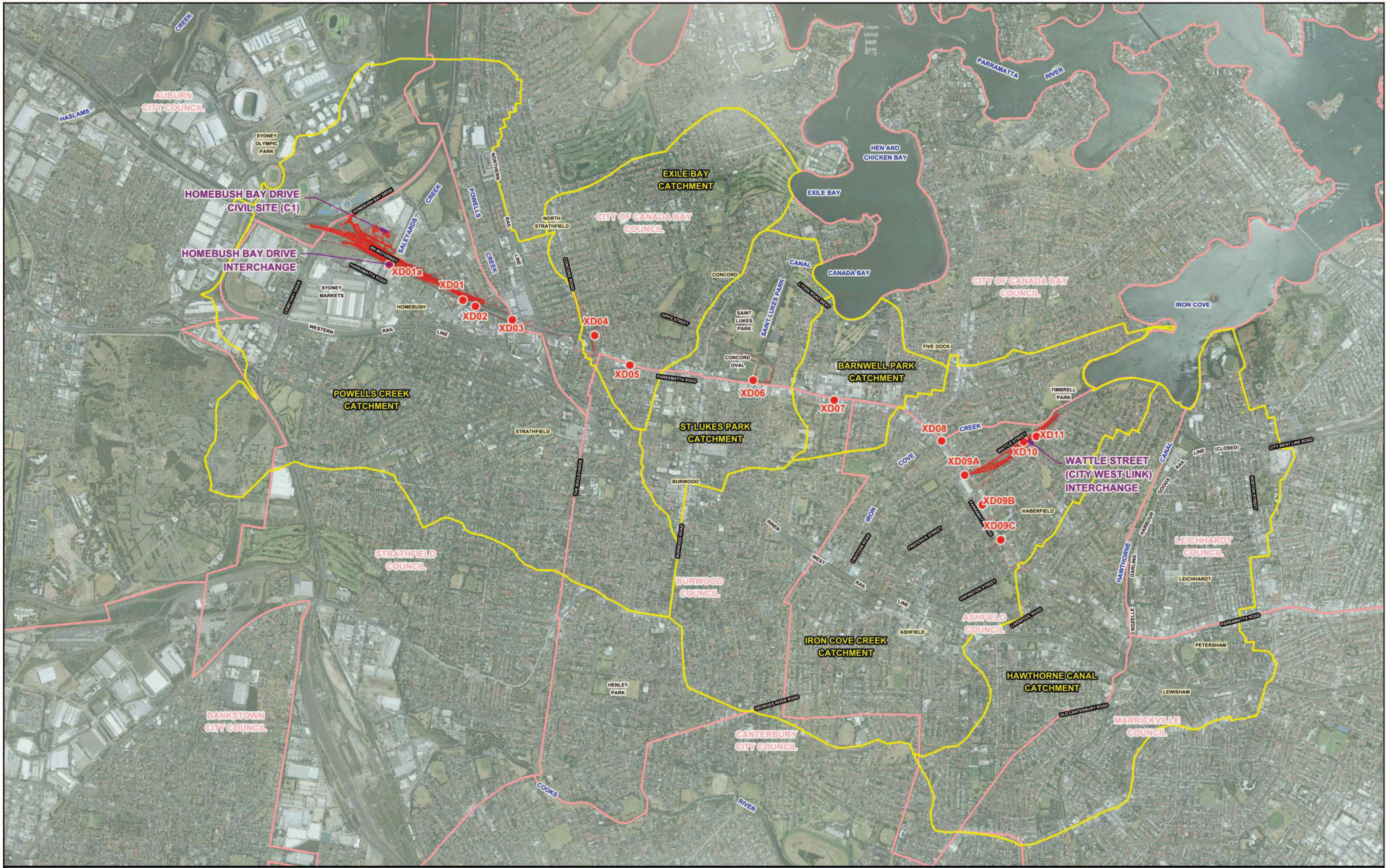


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Scale: 1:25,000 @ A3

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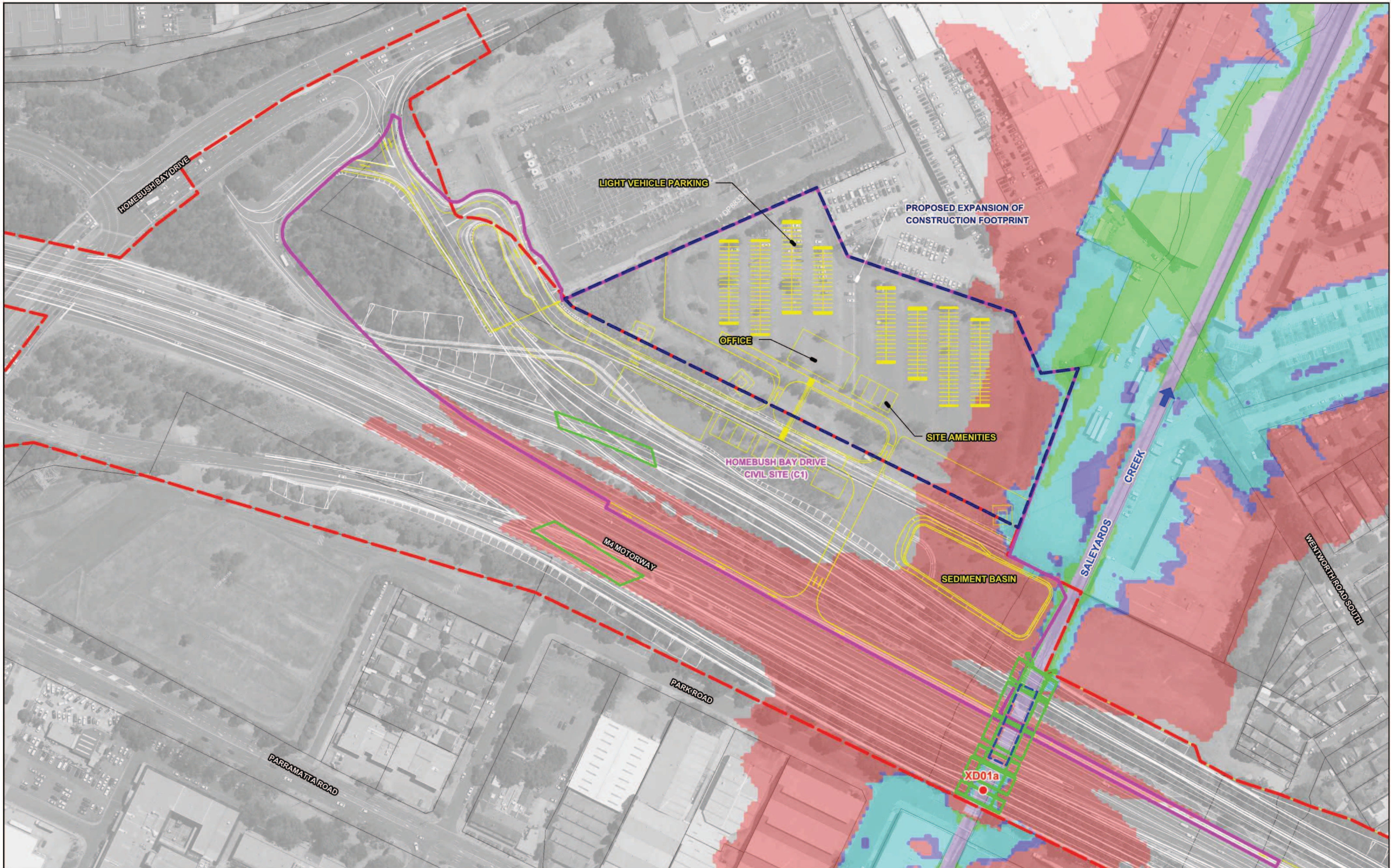
**LEGEND**

- Catchment Boundary
- LGA Boundary
- Road Design Strings
- XD01 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure S1

LOCATION PLAN

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**LEGEND**

- Construction Footprint
- Construction Site Boundary
- Indicative Construction Site Layout
- XD01a — Location of Existing Cross Drainage Structures along M4 East Corridor
- Surface Earthworks
- Existing Bridge Structure
- Proposed Bridge Structure
- Existing Drainage Network

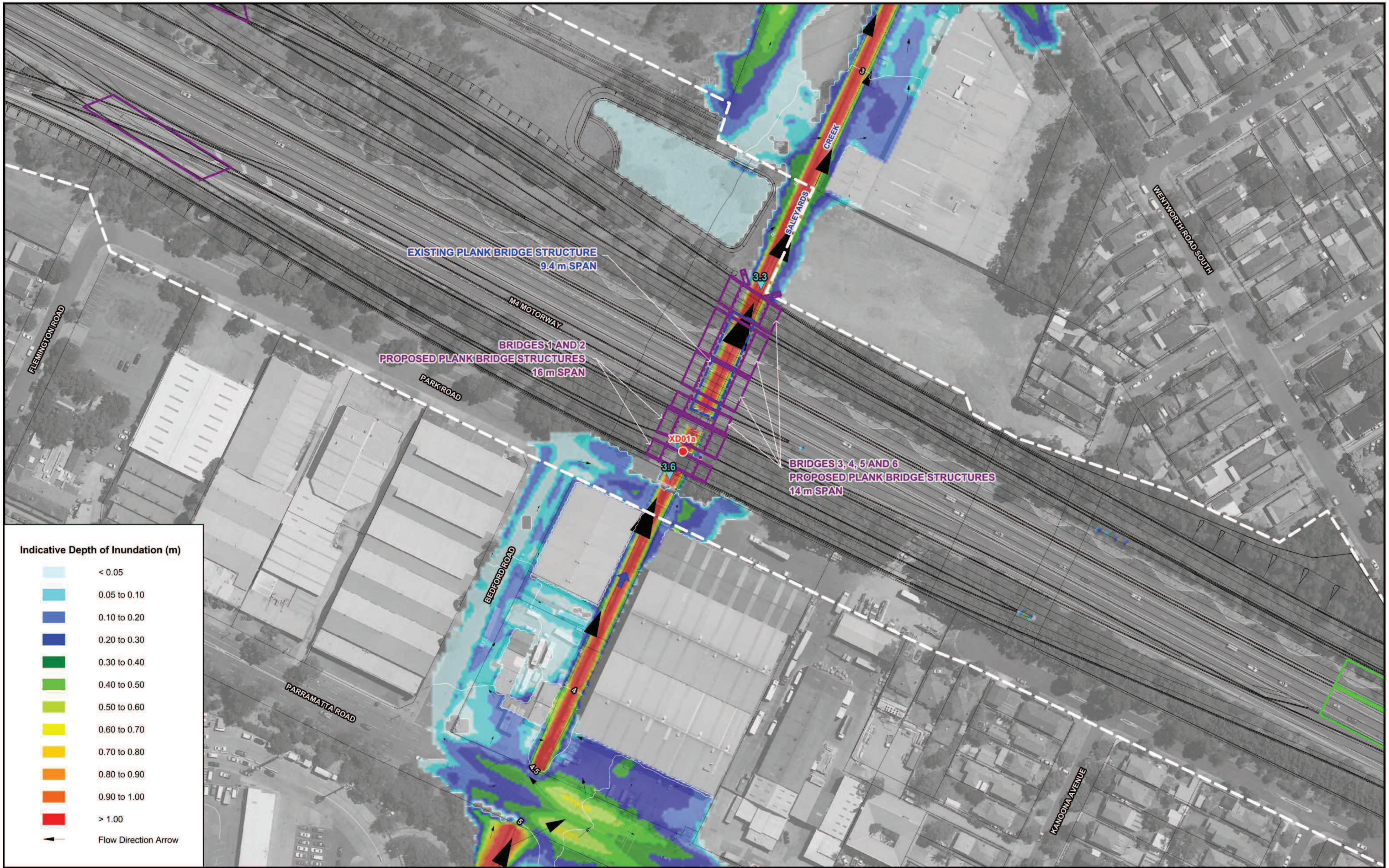
**INDICATIVE FLOOD EXTENTS**

- 5 Year ARI
- 20 Year ARI
- 100 Year ARI
- 200 Year ARI
- PMF

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.1

INDICATIVE FLOOD EXTENTS - PRESENT DAY CONDITIONS
HOMEBUSH BAY DRIVE CIVIL SITE (C1) EXPANSION

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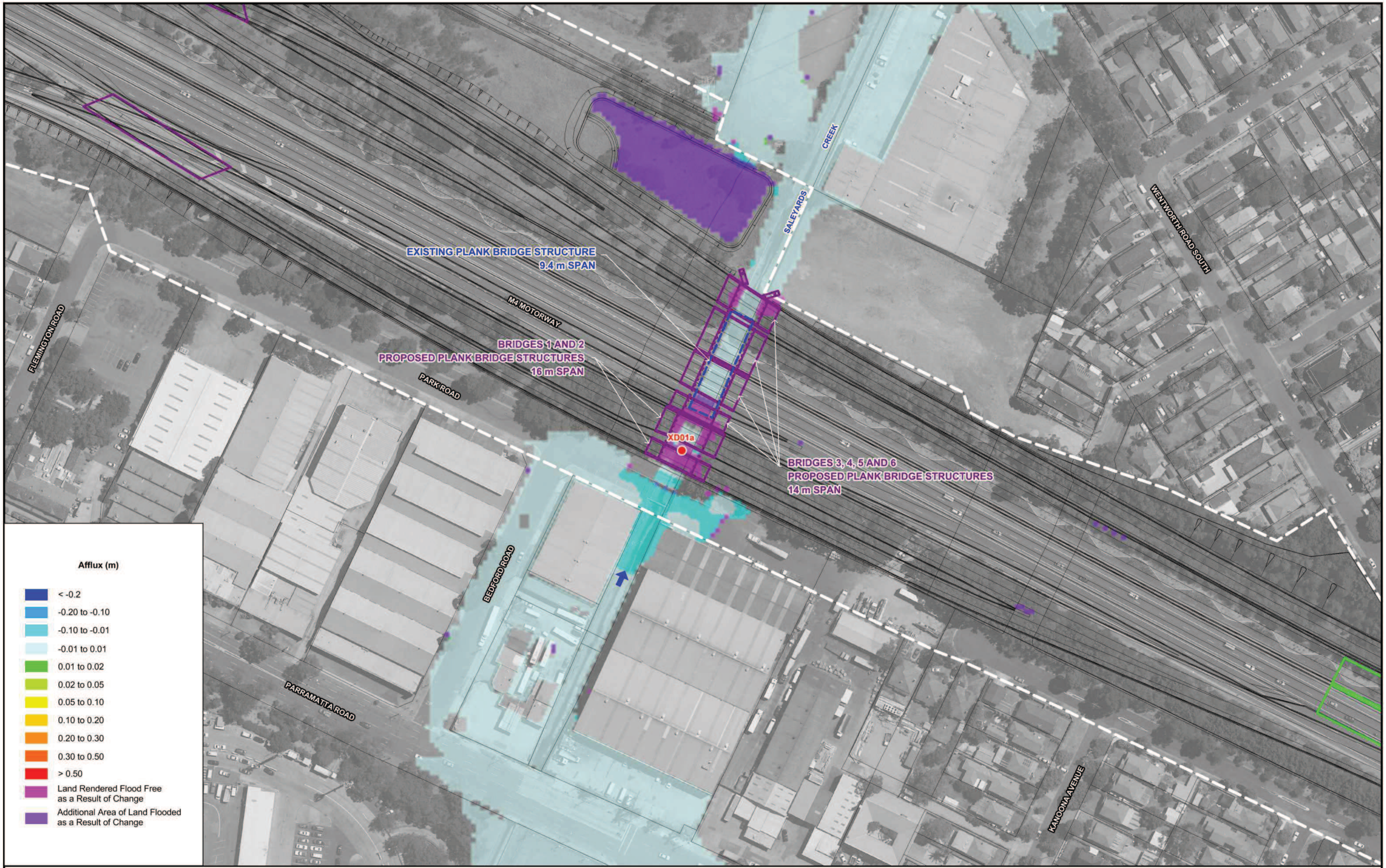
**LEGEND**

| | |
|---|---|
| Road Design Strings | Existing Bridge Structure |
| Water Surface Elevation Contours (m AHD) | Proposed Bridge Structure |
| XD01a Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road | Tunnel Dive Structure |
| | Cut and Cover Tunnel |
| | Driven Tunnel |
| Project Corridor | |
| 3.6 Peak Flood Level (m AHD) | |

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.2

POST-CONSTRUCTION FLOODING PATTERNS
HOMEBUSH BAY DRIVE INTERCHANGE - 100 YEAR ARI

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**LEGEND**

Road Design Strings

XD01a Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road

Project Boundary

Existing Bridge Structure

Proposed Bridge Structure

Tunnel Dive Structure

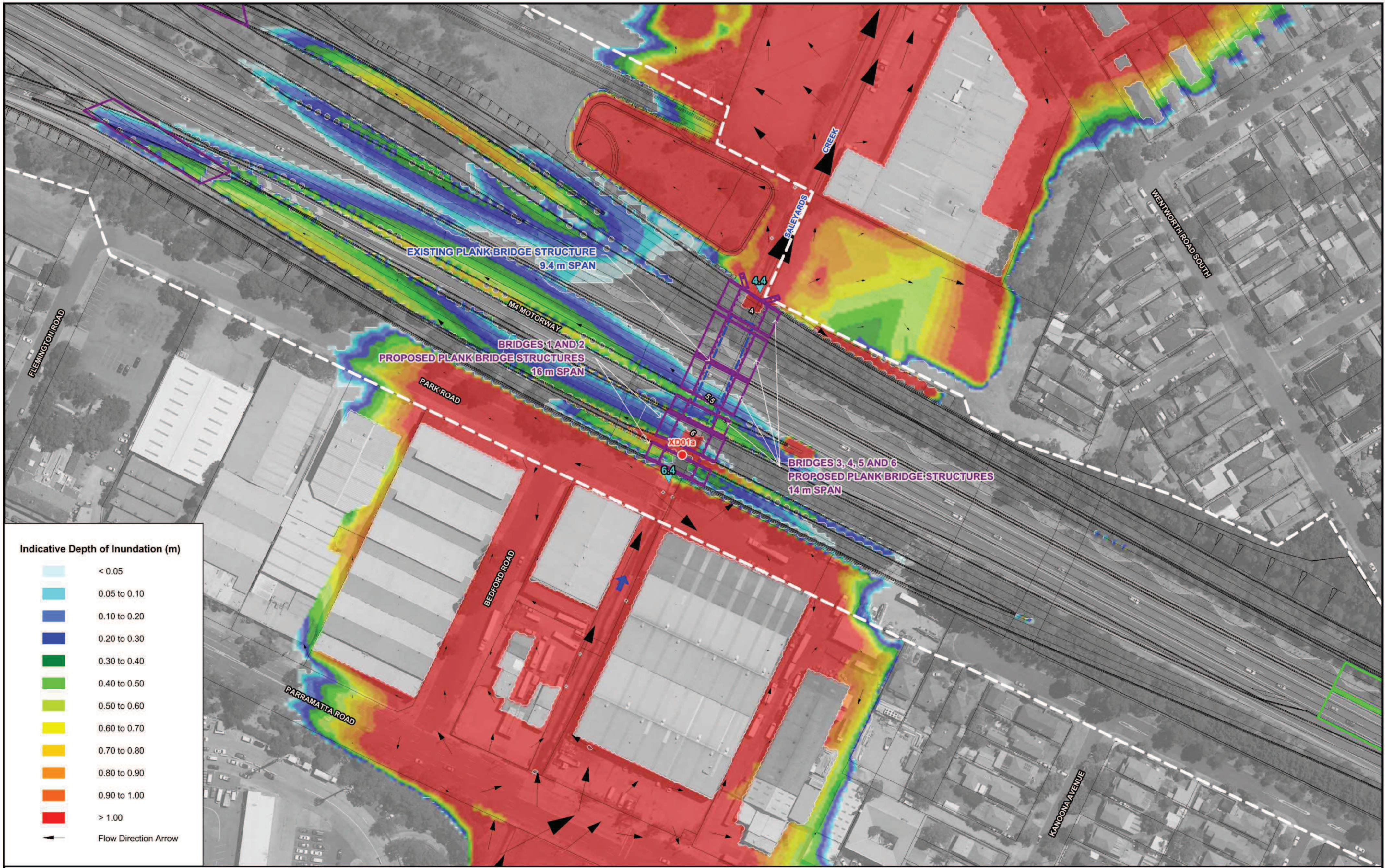
Cut and Cover Tunnel

Driven Tunnel

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.3

IMPACT OF M4 EAST POST-CONSTRUCTION ON FLOOD BEHAVIOUR
HOMEBUSH BAY DRIVE INTERCHANGE - 100 YEAR ARI

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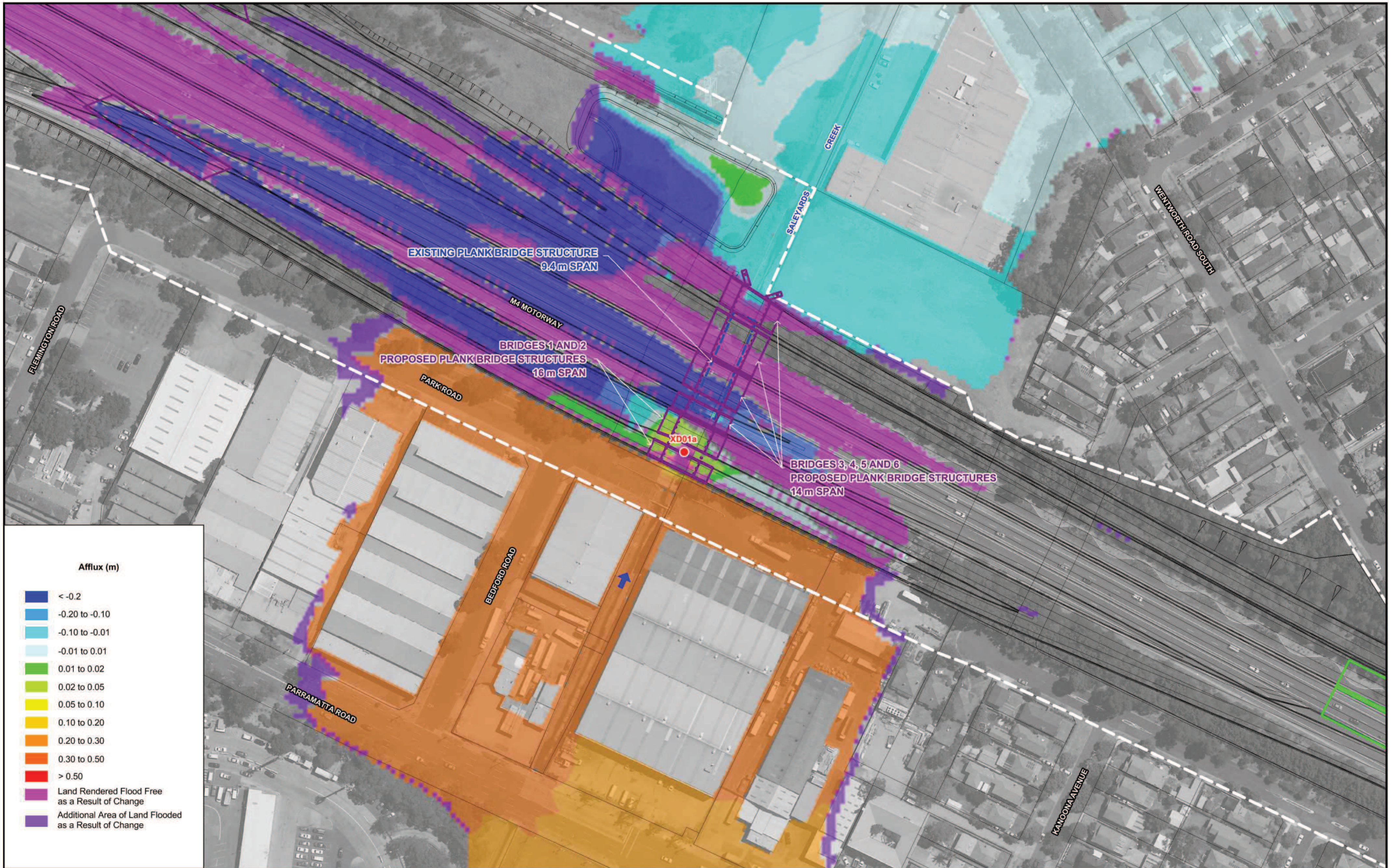
LEGEND

| | |
|---|---|
| Road Design Strings | Existing Bridge Structure |
| 4.5 Water Surface Elevation Contours (m AHD) | Proposed Bridge Structure |
| XD01a Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road | Tunnel Dive Structure |
| | Cut and Cover Tunnel |
| | Driven Tunnel |
| Project Corridor | |
| 3.6 Peak Flood Level (m AHD) | |

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.4

POST-CONSTRUCTION FLOODING PATTERNS
HOMEBUSH BAY DRIVE INTERCHANGE - PMF

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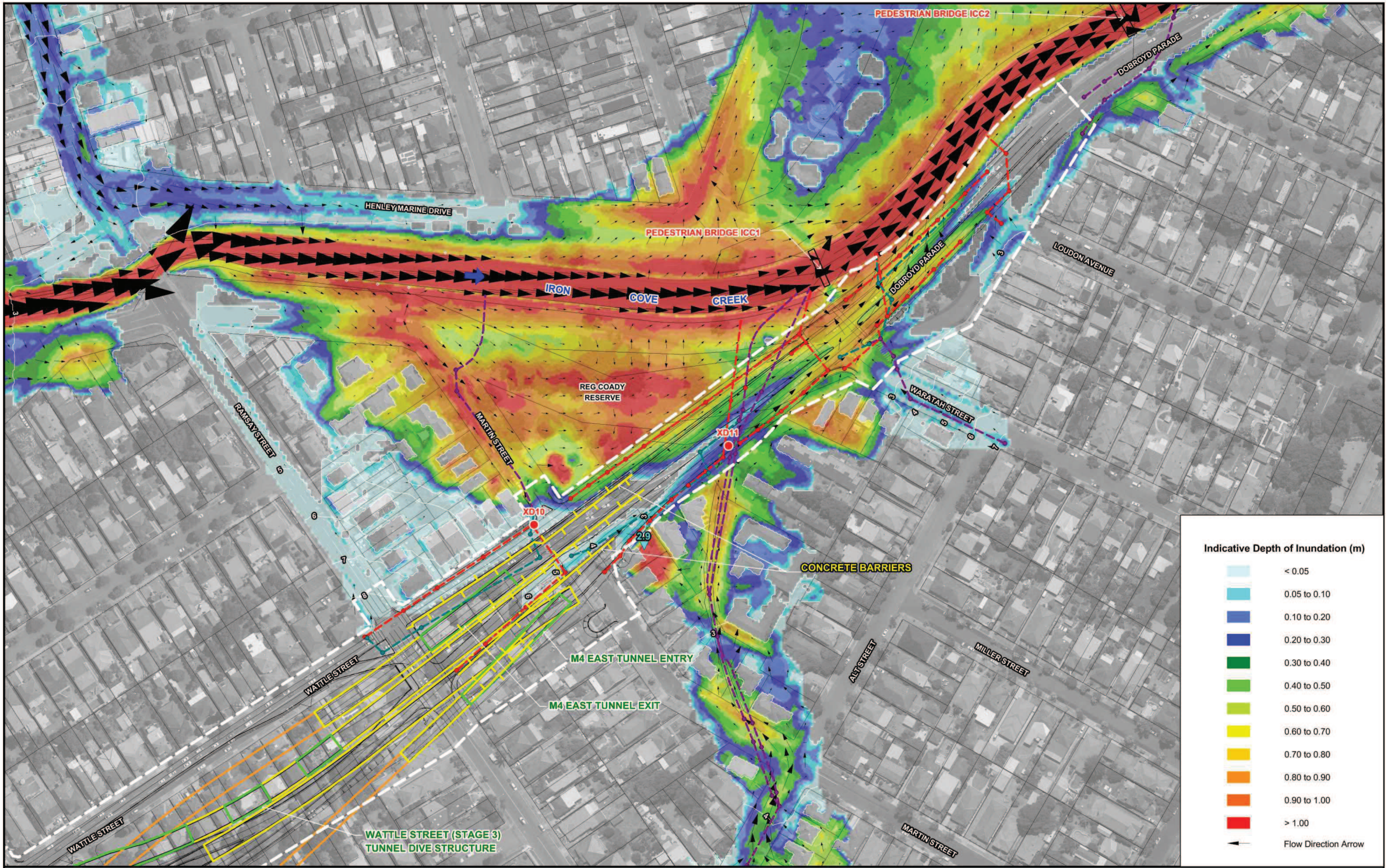
**LEGEND**

- Road Design Strings
- XD01a Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road
- Project Boundary
- Existing Bridge Structure
- Proposed Bridge Structure
- Tunnel Dive Structure
- Cut and Cover Tunnel
- Driven Tunnel

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.5

IMPACT OF M4 EAST POST-CONSTRUCTION ON FLOOD BEHAVIOUR
HOMEBUSH BAY DRIVE INTERCHANGE - PMF

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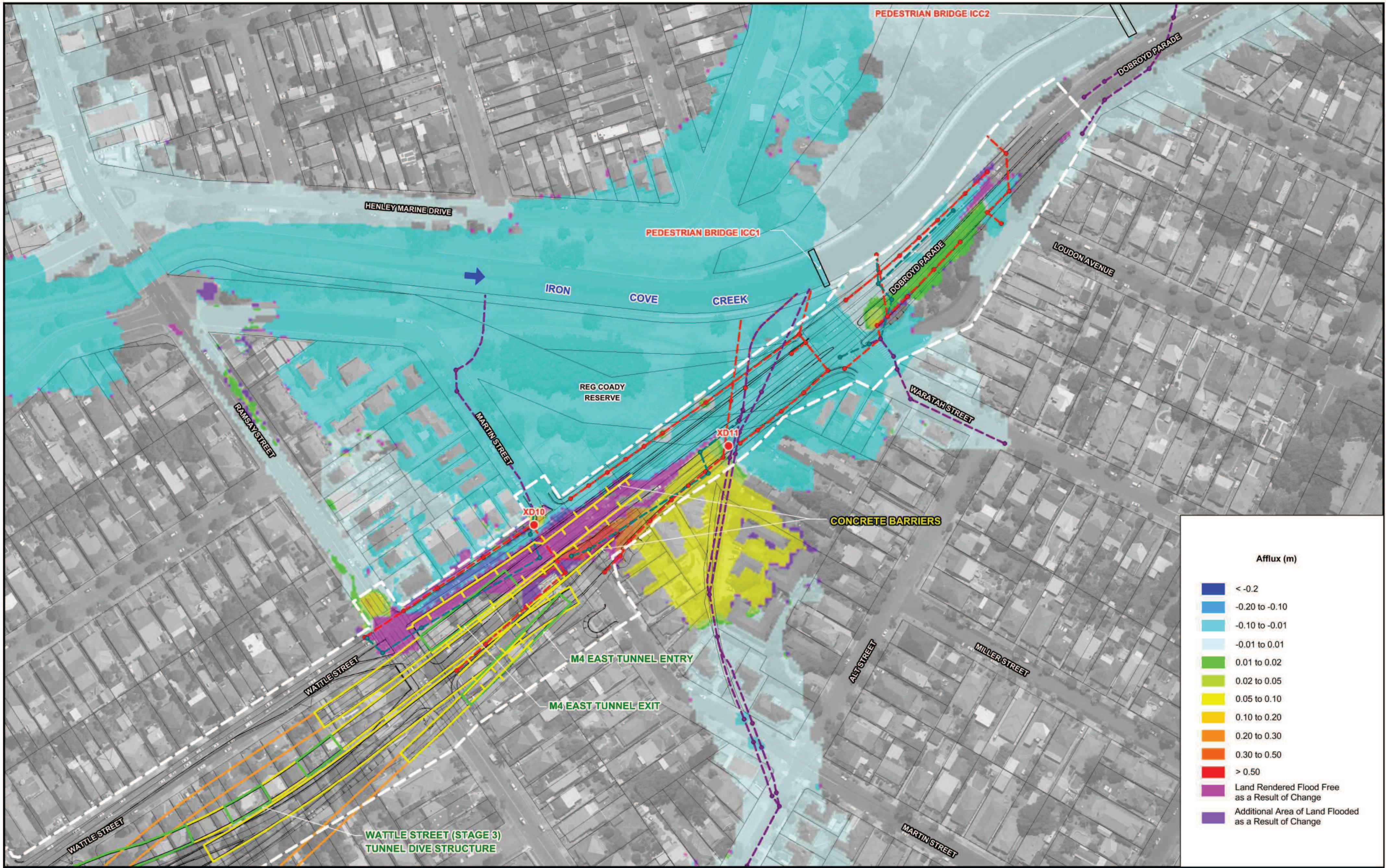
**LEGEND**

- Road Design Strings
- Water Surface Elevation Contours (m AHD)
- XD11 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road
- Project Boundary
- Bridge
- Tunnel Dive Structure
- Cut and Cover Tunnel
- Driven Tunnel
- Existing Drainage Network
- Existing Drainage Network to be Demolished
- Proposed Drainage Network
- 2.9 Peak Flood Level (m AHD)

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.6

POST-CONSTRUCTION FLOODING PATTERNS
WATTLE STREET (CITY WEST LINK) INTERCHANGE - 100 YEAR ARI

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LEGEND

Road Design Strings

XD11 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road

Project Boundary

Bridge

Tunnel Dive Structure

Cut and Cover Tunnel

Driven Tunnel

Existing Drainage Network

Existing Drainage Network to be Demolished

Proposed Drainage Network

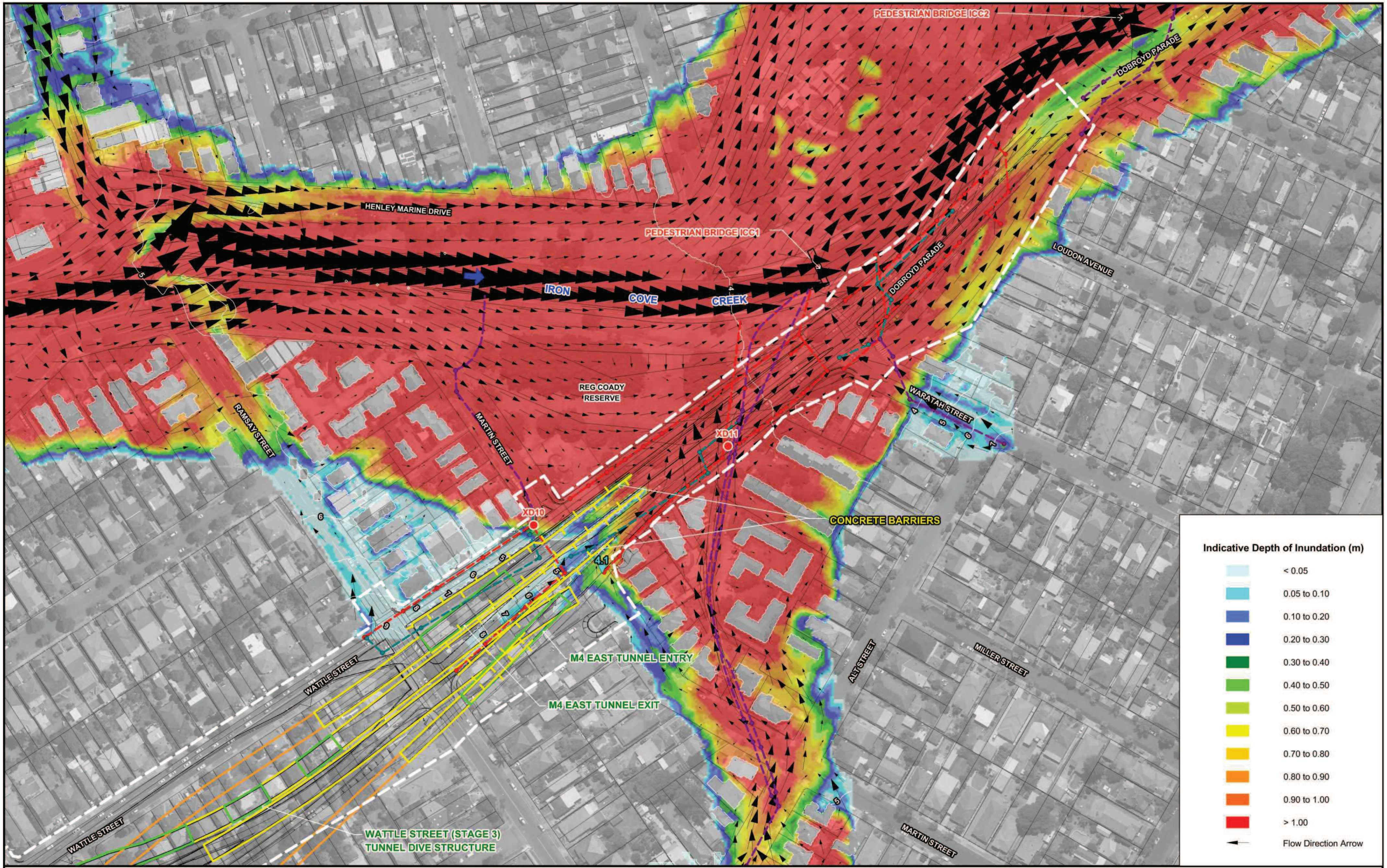
Lyall & Associates

**WESTCONNEX M4 EAST EIS**

**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.7

IMPACT OF M4 EAST POST-CONSTRUCTION ON FLOOD BEHAVIOUR
WATTLE STREET (CITY WEST LINK) INTERCHANGE - 100 YEAR ARI

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LEGEND

- Road Design Strings
- Water Surface Elevation Contours (m AHD)
- XD11 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road
- Project Boundary
- Bridge
- Tunnel Dive Structure
- Cut and Cover Tunnel
- Driven Tunnel
- Existing Drainage Network
- Existing Drainage Network to be Demolished
- Proposed Drainage Network
- 2.9 Peak Flood Level (m AHD)

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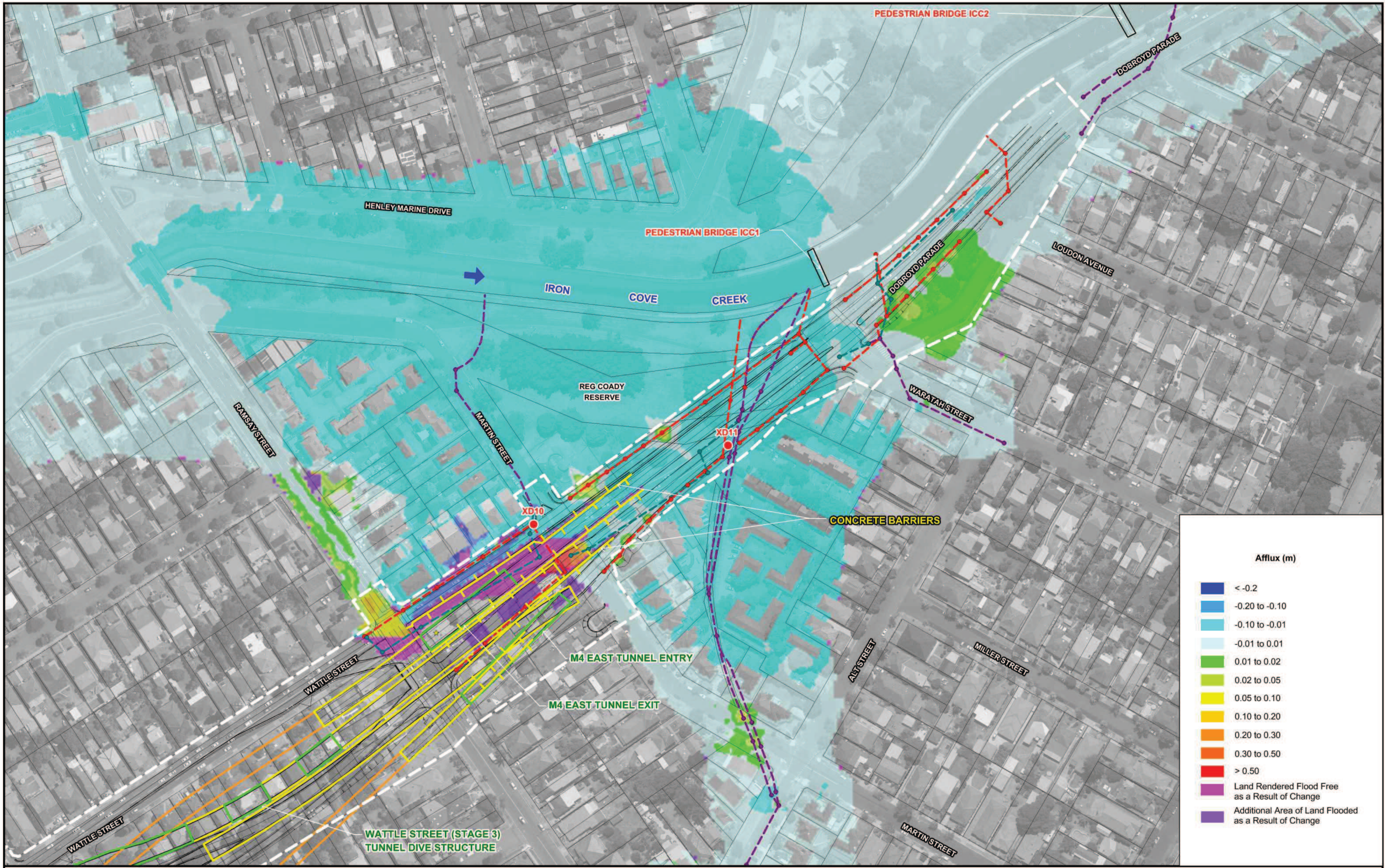
**WESTCONNEX M4 EAST EIS**

**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.8

POST-CONSTRUCTION FLOODING PATTERNS

WATTLE STREET (CITY WEST LINK) INTERCHANGE - PMF

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Scale: 1:2,000 @ A3

LEGEND

Road Design Strings

XD11 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road

Project Boundary

Bridge

Tunnel Dive Structure

Cut and Cover Tunnel

Driven Tunnel

Existing Drainage Network

Existing Drainage Network to be Demolished

Proposed Drainage Network

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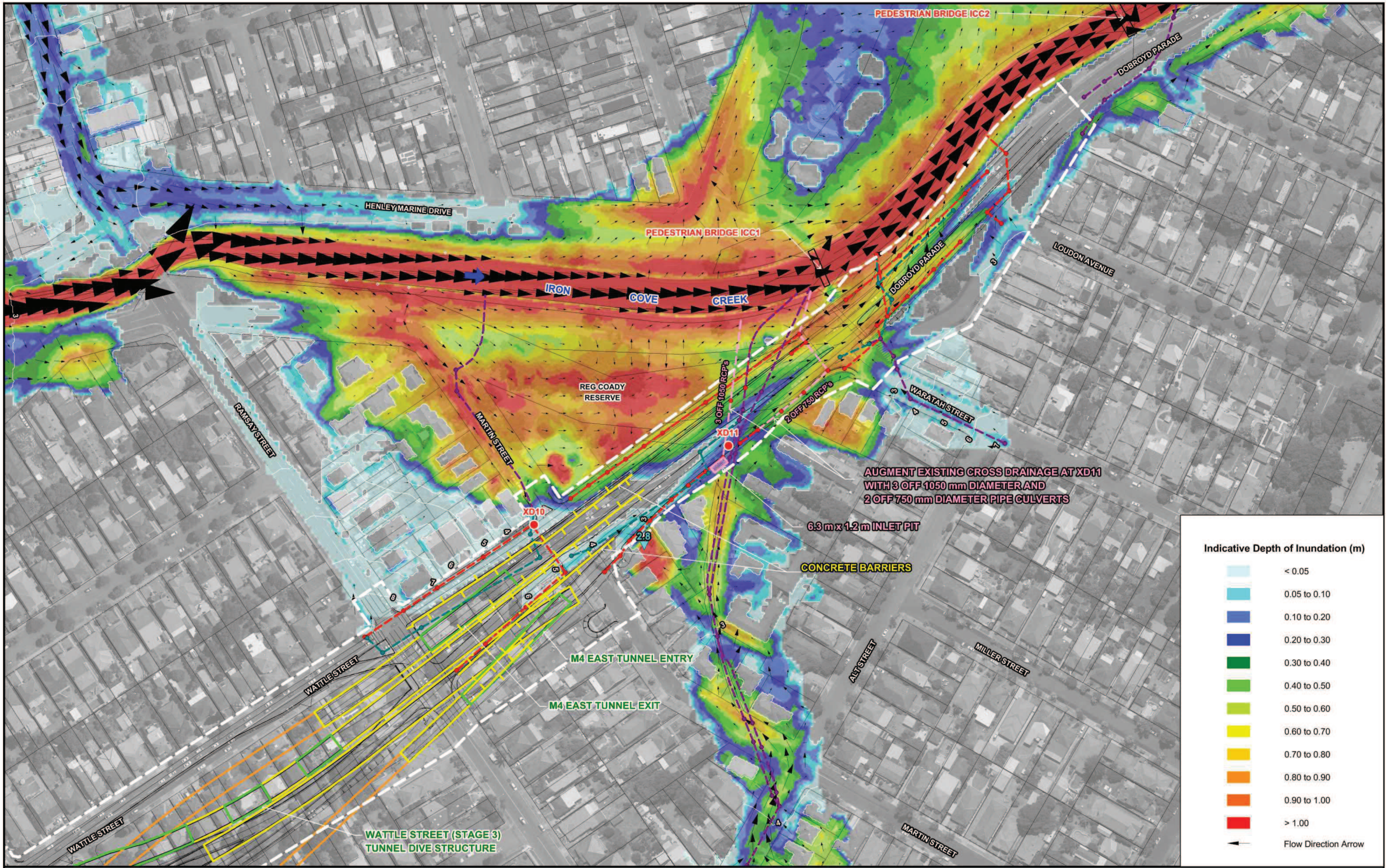
**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.9

IMPACT OF M4 EAST POST-CONSTRUCTION ON FLOOD BEHAVIOUR
WATTLE STREET (CITY WEST LINK) INTERCHANGE - PMF

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Lyall & Associates

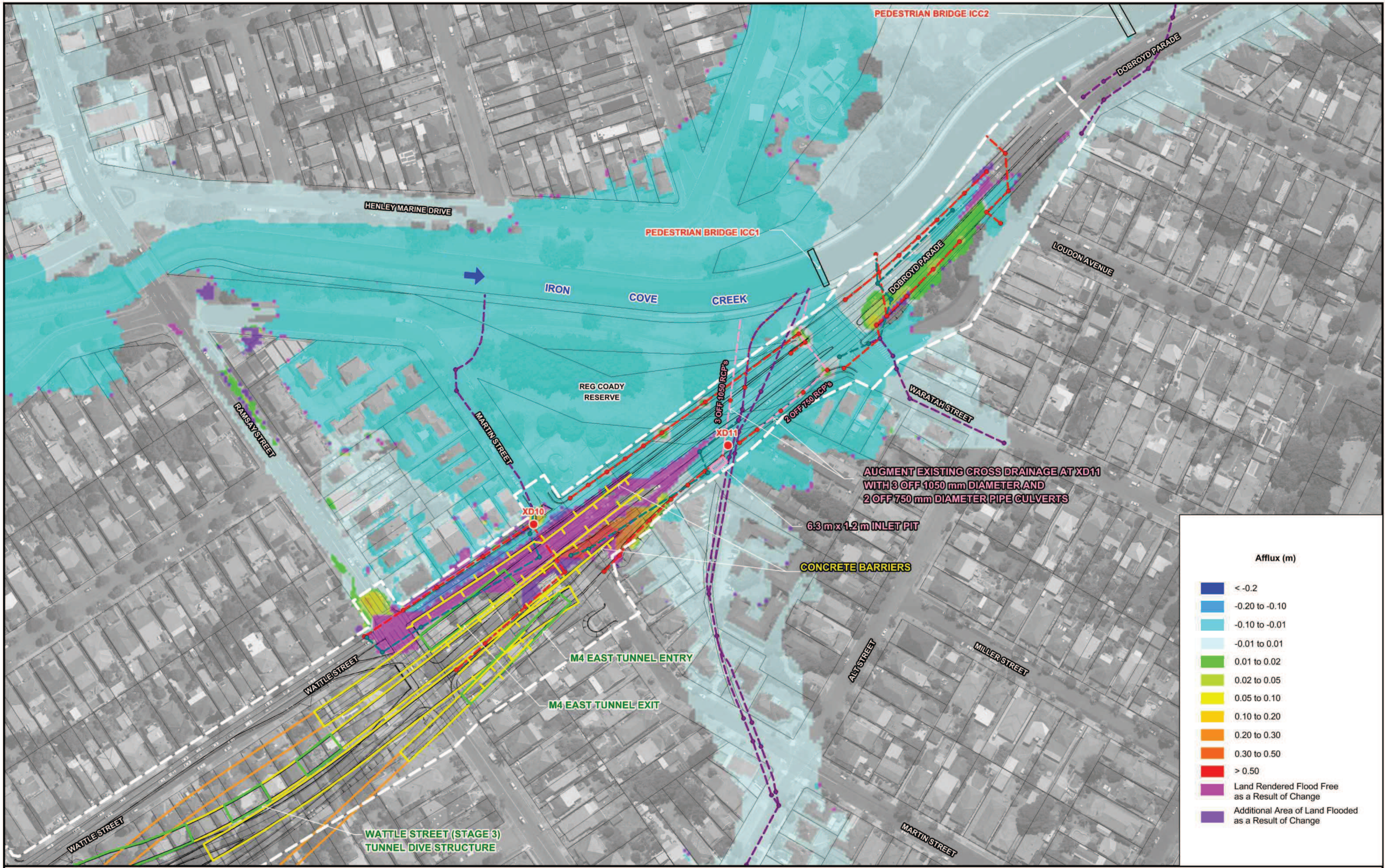
LEGEND

Road Design Strings
Water Surface Elevation Contours (m AHD)
XD11 Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road
Project Boundary
Bridge
Tunnel Dive Structure
Cut and Cover Tunnel
Driven Tunnel
Existing Drainage Network
Existing Drainage Network to be Demolished
Proposed Drainage Network
2.9 Peak Flood Level (m AHD)

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.10

POST-CONSTRUCTION FLOODING PATTERNS
WATTLE STREET (CITY WEST LINK) INTERCHANGE WITH MITIGATION - 100 YEAR ARI

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LEGEND

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| Road Design Strings | |
| XD11 | Location of Existing Cross Drainage Structures along M4 Motorway/Parramatta Road |
| Project Boundary | |
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| Existing Drainage Network to be Demolished | |
| Proposed Drainage Network | |

Lyall & Associates

**WESTCONNEX M4 EAST EIS**
**FLOOD IMPACT ASSESSMENT OF ALTERNATIVE DESIGN ARRANGEMENTS**

Figure 4.11

IMPACT OF M4 EAST POST-CONSTRUCTION ON FLOOD BEHAVIOUR
WATTLE STREET (CITY WEST LINK) INTERCHANGE WITH MITIGATION - 100 YEAR ARI

# Appendix F

## Urban design and visual impact assessment of design changes

WestConnex

# Roads and Maritime Services

WestConnex M4 East

Urban design and visual impact assessment of design changes

December 2015

**Prepared for**

Roads and Maritime Services

**Prepared by**

*AECOM Australia*

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# Contents

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# 1 Introduction

## 1.1 Overview of the project

Sydney Motorway Corporation (SMC), on behalf of the NSW Roads and Maritime Services (Roads and Maritime), is seeking approval to upgrade and extend the M4 Motorway from Homebush Bay Drive at Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield, in inner western Sydney. These proposed works are described as the M4 East project (the project).

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). The project was declared by the Minister for Planning to be State significant infrastructure and critical State significant infrastructure and an environmental impact statement (EIS) was therefore required.

An EIS was prepared for the project and was submitted in September 2015. The EIS and the associated specialist studies were then placed on public exhibition for a 55 day period, during which time the community and stakeholders were invited to make comments on the project and the EIS.

The project is a component of WestConnex, which is a proposal to provide a 33 kilometre motorway linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct as shown in **Figure 1.1**. The individual components of WestConnex are:

- M4 Widening – Pitt Street at Parramatta to Homebush Bay Drive (planning approval granted and under construction)
- M4 East (the subject of this report)
- New M5 – King Georges Road at Beverly Hills to St Peters (EIS currently on public display)
- King Georges Road Interchange Upgrade (planning approval granted)
- M4–M5 Link – Haberfield to St Peters, including the Southern Gateway and Southern Extension (undergoing concept development).


**Figure 1.1** WestConnex

Separate planning applications will be lodged for each individual component project. Each project will be assessed separately, but the impacts of each project will also be considered in the context of the wider WestConnex.

The NSW Government initially established the WestConnex Delivery Authority (WDA) to deliver WestConnex. WDA was established as an independent public subsidiary corporation of Roads and Maritime and was project managing the planning approval process for the project on its behalf.

Since June 2015, the project delivery functions of WDA have been under transfer to SMC, following a decision to evolve WestConnex governance into a single decision-making entity. The transfer of functions was completed on 30 September 2015.

SMC is a corporation established under the Corporations Act 2001 (Commonwealth) with a majority independent board of nine directors. The NSW Roads Minister and NSW Treasurer are joint shareholders. It is a public financial enterprise established by regulation.

Notwithstanding this, for the purpose of the planning application for the M4 East project, Roads and Maritime is the proponent.

## 1.2 Project location

The project is located in the inner west region of Sydney within the Auburn, Strathfield, Canada Bay, Burwood and Ashfield local government areas (LGAs). The project travels through 10 suburbs: Sydney Olympic Park, Homebush West, Homebush, North Strathfield, Strathfield, Concord, Burwood, Croydon, Ashfield and Haberfield. The location of the project is shown in **Figure 1.2**.

The project is generally located within the M4 and Parramatta Road corridor, which links Broadway at the southern end of the Sydney central business district (CBD) and Parramatta in Sydney's west, about 20 kilometres to the west of the Sydney CBD. This corridor also provides the key link between the Sydney CBD and areas further west of Parramatta (such as Penrith and western NSW).

The western end of the project is located at the interchange between Homebush Bay Drive and the M4, about 13 kilometres west of the Sydney CBD. The project at this location would tie in with the M4 Widening project in the vicinity of Homebush Bay Drive. The tunnels which form part of the project would dive from the centre of the M4, west of the existing pedestrian footbridge over the M4 at Pomeroy Street, and would continue under the northern side of the existing M4 and Parramatta Road, before crossing beneath Parramatta Road at Broughton Street, Burwood. The tunnels would under the southern side of Parramatta Road until the intersection of Parramatta Road and Wattle Street at Haberfield. Ramps would connect the tunnels to Parramatta Road and Wattle Street (City West Link) at the eastern end of the project. The tunnels would end in a stub connection to the possible future M4–M5 Link (which is subject to planning approval), near Alt Street.

The project would include interchanges between the tunnels and the above ground road network, along with other surface road works, at the following locations:

- M4 and Homebush Bay Drive interchange at Sydney Olympic Park and Homebush
- Powells Creek, near George Street at North Strathfield
- Queen Street, near Parramatta Road at North Strathfield
- M4 and Sydney Street, Concord Road and Parramatta Road interchange at North Strathfield
- Wattle Street (City West Link), between Parramatta Road and Waratah Street at Haberfield
- Parramatta Road, between Bland Street and Orpington Street at Ashfield and Haberfield.

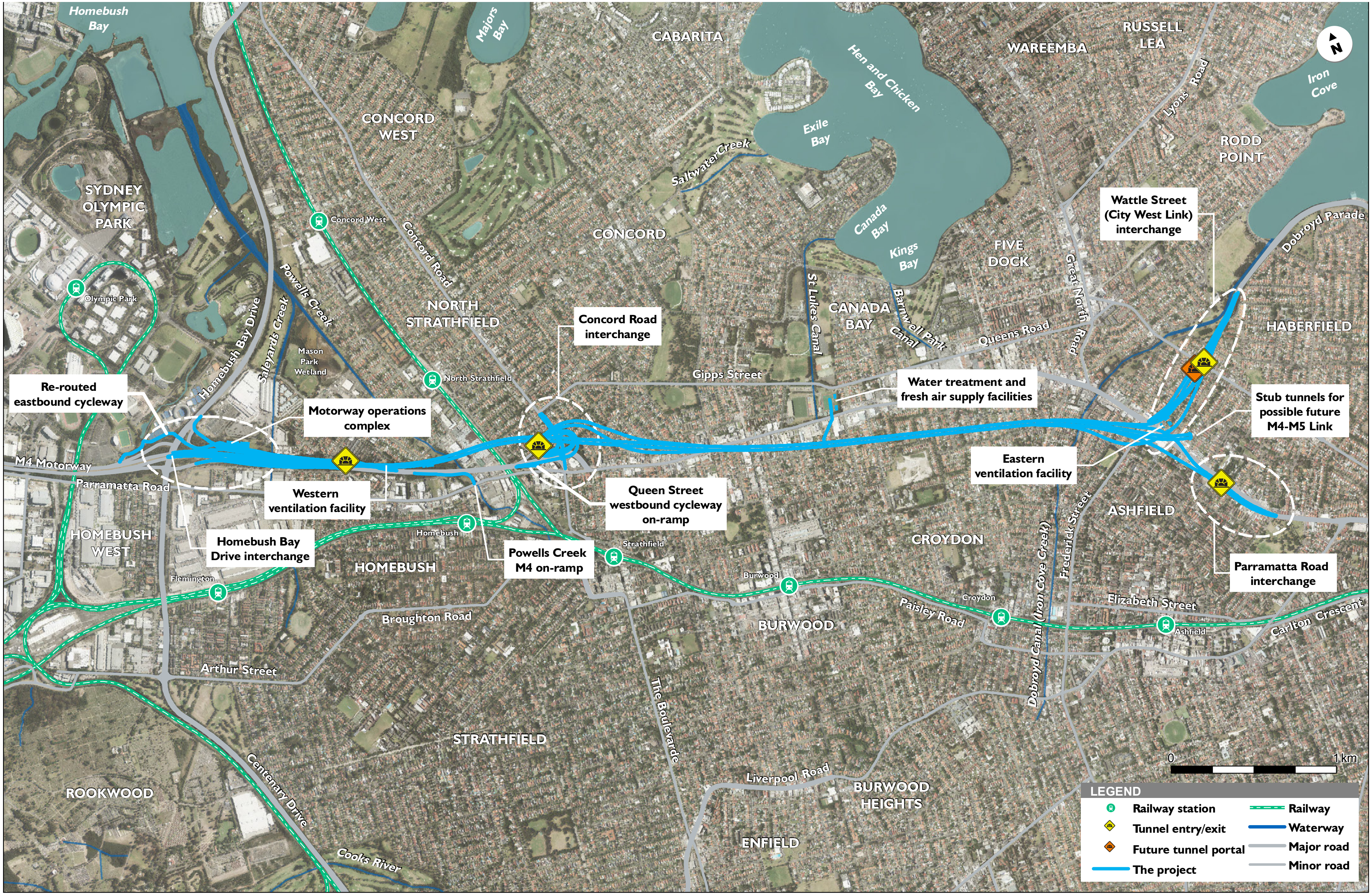


**Figure 1.2 Project location**

## 1.3 Purpose of this report

This report has been prepared to outline and assess the impact of alternative design options that have been identified since the exhibition of the EIS. As outlined in section 5.1 of the EIS, the project description was based on concept preferred design and will be refined during detailed design. The EIS notes that the final design of the M4 East project that is built could therefore vary from its description in the EIS.

This report assesses the urban design and visual impact assessment impacts of the proposed design changes, as described in **Chapter 2** (Proposed design changes).

## 1.4 Assessment methodology

### Urban design

This urban design assessment has both compared the proposed design changes with the preferred design assessed in EIS, and assessed the potential impacts of the modified design in accordance with the SEARs.

The scope of this urban design assessment is limited to the 'operational motorway' described in **Chapter 2** (Proposed design changes), and does not include the temporary and/or ancillary works associated with the construction phase of the proposal.

### Landscape and visual impact assessment

The LVIA methodology is as per the EIS, with the exception that:

- For Receiver location 6 – Reg Coady Reserve near Iron Cove Creek looking west, a detail view of the amended design has been added for the 12-18 months and 10 year photomontages, to provide an additional level of detail for this portion of the project
- A brief comparison of potential impacts has been undertaken between the preferred design assessed in the EIS and the proposed design changes.

# 2 Proposed design changes

## 2.1 Description of design change – Wattle Street (City West Link) interchange

In the EIS, the Wattle Street (City West Link) interchange included separate cut and cover tunnel structures. The interchange as described in the EIS is depicted in **Figure 2.1** as an oblique elevation.

As a result of ongoing design development, the configuration of the Wattle Street interchange is proposed to be modified. The purpose of these changes is to combine the dive and cut and cover structures for both the M4 East ramps and the M4–M5 Link ramps.

The below sections outline the proposed changes to the configuration of the interchange. The new arrangement is shown in **Figure 2.2** as an oblique elevation and **Figure 2.3** in plan view. An indicative view of the revised interchange is shown in **Figure 2.4.**

### M4 East tunnel exit to Wattle Street

The M4 East tunnel exit to Wattle Street would not be altered significantly. The tunnel portal would remain on the northern side of Ramsay Street.

The dedicated right turn bay at the Waratah Street signalised intersection would remain for traffic exiting the eastbound mainline tunnel only.

### M4 East tunnel entrance from Wattle Street

The M4 East tunnel entry from Wattle Street would be relocated further to the east, so that the on-ramp would be the eastern-most (kerbside) lane while the surface Wattle Street lanes would continue as the centre lanes. The dive structure for this on-ramp would start on the southern side of Martin Street. The tunnel portal would remain on the northern side of Ramsay Street.

There would be no other change to the on-ramp.

### Wattle Street surface adjustments

The surface Wattle Street eastbound lanes would not change as part of the modification of the interchange.

The surface Wattle Street westbound lanes would be realigned to the east of its existing alignment; however, it would continue in the centre lanes (instead of the kerbside lanes as described in the EIS). To do this, the surface lanes would travel over the cut and cover sections of the M4–M5 Link on- and off-ramps.

South of Ramsay Street, the westbound surface Wattle Street lanes would still split as described in the EIS, two separate sets of lanes providing access to Parramatta Road westbound, and Parramatta Road eastbound or Frederick Street southbound.

North of Waratah Street, the surface works would remain on the same general alignment.

### M4–M5 Link on- and off-ramps tunnels

The M4–M5 Link cut and cover structures would start in about the same location as described in the EIS, but would be realigned so that they are positioned between the M4 East on- and off-ramps. The on- ramp dive structure would be lengthened, while the off-ramp dive structure would be shortened.

### Martin Street intersection works

As a result of the realignment of the M4 East westbound tunnel entry from Wattle Street, the on-ramp would become the eastern-most (kerbside) lane, while the surface Wattle Street lanes would continue as the centre lanes. A cul-de-sac would therefore be established at Martin Street on the eastern side of Wattle Street. This reconfiguration would mean that no access to the Wattle Street lanes or the M4 East on-ramp would be provided from Martin Street to Wattle Street.

Alternative access to Wattle Street would be available via Alt Street and Ramsay Street/Waratah Street. As the on-ramp for the M4 East tunnel entrance from Wattle Street would start on the northern side of Martin Street, access to the M4 East tunnel entrance would be via the intersection of Waratah Street and Wattle Street.

### 2.1.1 Landscape, visual and urban design specific aspects

#### M4 East entry and exit structures

The proposed design change would reduce the overall operational footprint of this portion of the project.

The relocation of the dive structure of the M4 East tunnel entry from Wattle Street would bisect the effective planting area, however would also increase the amount of deep soil planting and reduce the proportion of that landscaping required to be upon cut-and-cover structure.

The amendment would not increase the complexity or overall length of the pedestrian paths across the intersection.

#### M4 East cut-and-cover structures

The proposed design change would result in a potential net gain of deep soil planting and a reduction in cut-and-cover structure planting.

On the eastern side of Ramsay Street the cut-and-cover structure to the north and south of the dive structure of the M4 East tunnel entry from Wattle Street would be significantly reduced in area.

On the western side of Ramsay Street, the cut-and-cover structure immediately to the south of the at-grade, east bound portion of Wattle Street, adjacent to the proposed slip-lane, would be increased. As a result the area of landscaping over cut-and-cover structure, rather than deep soil, would increase.

The cut-and-cover structure on the western side of Ramsay Street immediately to the south of the at-grade, west bound portion of Wattle Street, would be reduced.

#### M4–M5 Link on- and off-ramps tunnels

The proposed design change would have no impact on the previous at-grade road design, and does not alter the total project footprint.

The design change would alter the amount of cut-and-cover structure and landscaping potential associated with the structures, slightly increasing the total landscaping area above both the entry and exit portal structures.

#### Wattle Street surface adjustments

*Martin Street*

This amendment would create a cul-de-sac and an adjacent area of residual land at the northern end of Martin Street which would create additional area for landscape/ screen planting in this portion of the project.

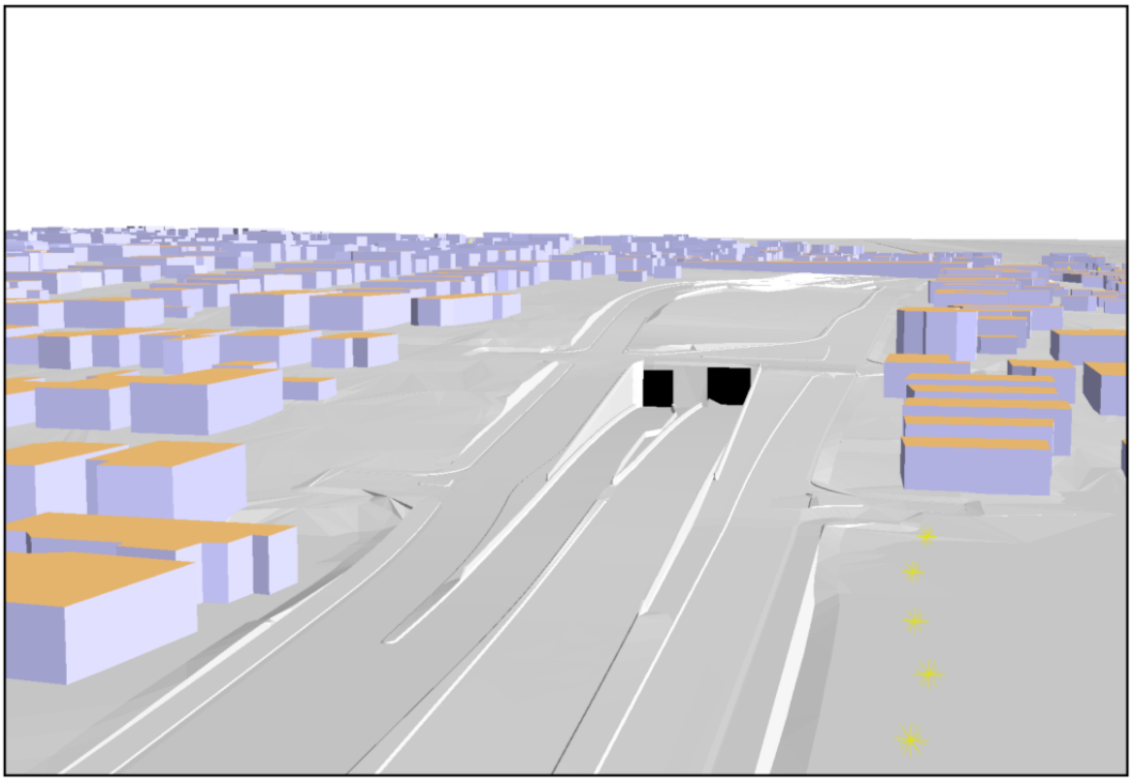

**Figure 2.1 EIS Wattle Street interchange (oblique elevation, facing south)**

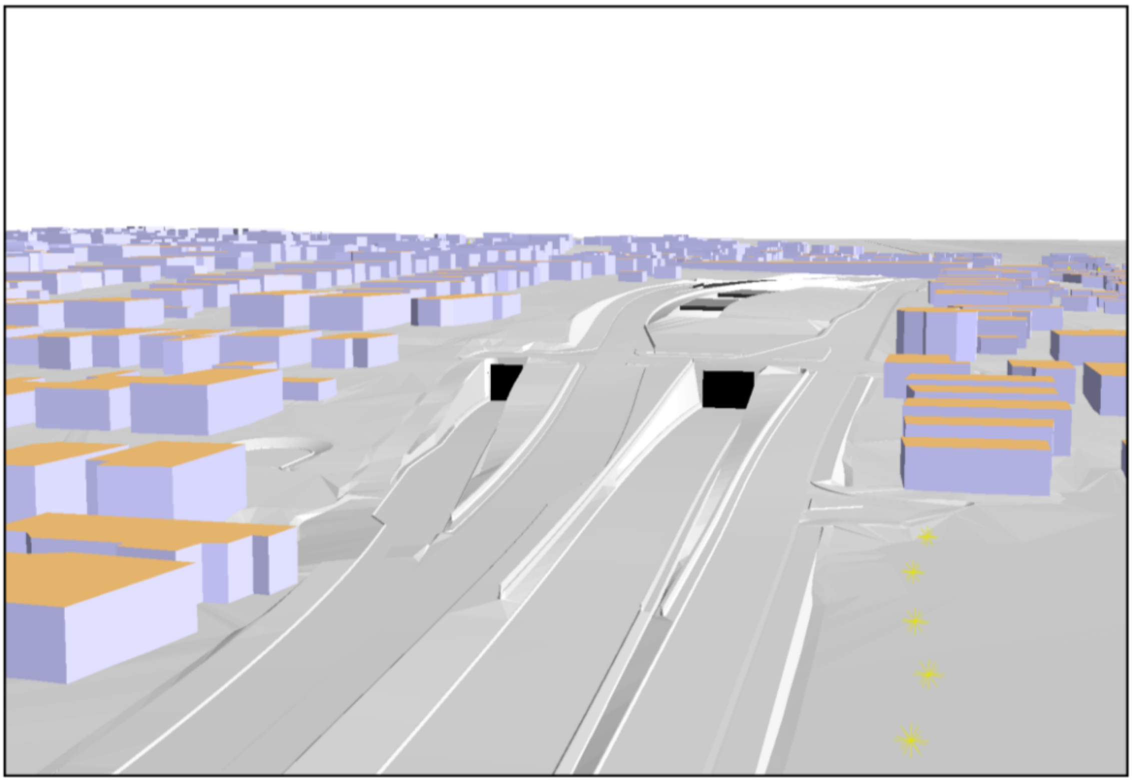

**Figure 2.2 Reconfigured Wattle Street interchange (oblique elevation, facing south)**


Figure 2.3 Reconfigured Wattle Street (City West Link) interchange

**Figure 2.4** **Indicative view of the revised Wattle Street interchange, looking south along Wattle Street from near Reg Coady Reserve. This image is conceptual and is included for illustration purposes only**

## 2.2 Description of design change – Homebush Bay Drive re-design

In the EIS, the Homebush Bay Drive interchange included two major bridge structures near Saleyards Creek to carry surface M4 traffic over traffic entering and exiting the M4 East mainline tunnels. The layout of the traffic lanes could be considered counter-intuitive, with traffic lanes to and from the new mainline tunnels provided on the outside of traffic lanes to and from the surface M4. This arrangement had the potential for the layout of the on- and off-ramps to be confusing for motorists.

Eastbound motorists wanting to enter the tunnel would have needed to use the northern (kerbside) lane, whereas drivers wanting to access the existing M4 (to the north of the tunnel) would have needed to use the southern lane. Westbound motorists wanting to continue on the M4 would have needed to go up and over a bridge and then back down onto the motorway rather than driving straight through at-grade. The proposed change would resolve these issues.

To maintain eastbound access to the existing M4 from Homebush Bay Drive, the design described in the EIS incorporated the construction of an elevated bridge up to eight metres in height adjacent to apartments on Verley Drive. The interchange as described in the EIS is depicted in **Figure 2.5** as an oblique elevation.

As a result of ongoing design development, the configuration of ramps and connections between the M4 and M4 East at the Homebush Bay Drive interchange is proposed to be modified. The purpose of these changes is to reduce the size of bridge structures, follow more direct grade lines and provide a more intuitive alignment for drivers entering and exiting at the Homebush Bay Drive interchange. The reconfiguration would also reduce potential visual and noise impacts on residents of Verley Drive.

The below sections outline the proposed changes to the configuration of this interchange. The new arrangement is shown in **Figure 2.6** as an oblique elevation and **Figure 2.7** in plan view. An indicative view of the revised interchange is shown in **Figure 2.8**.

### M4 Motorway surface realignment

There would be no change to the western connection to the M4 Widening project as described in section 5.5.1 of the EIS. Traffic lanes on the M4 would continue to be realigned so that the dominant traffic flow would be to and from the new mainline tunnels.

In the eastbound direction, the lane for M4 surface traffic would be realigned to the north of the existing traffic lanes, and would travel under a short bridge structure carrying the M4 East entry ramp from Homebush Bay Drive. This short bridge structure would replace the long bridge structure further to the east as described in the EIS. The M4 surface traffic lane would widen to two lanes as it joins with a lane from the Homebush Bay Drive on-ramp for M4 surface traffic.

In the westbound direction, the two traffic lanes for M4 surface traffic would be realigned to the south of the existing traffic lanes. These lanes would continue at grade (instead of on a large bridge structure, as described in the EIS) before merging with the existing M4 to the east of Homebush Bay Drive.

### Homebush Bay Drive eastbound on-ramp

As described in the EIS, the existing eastbound on-ramp from Homebush Bay Drive to the M4 would be realigned to the north.

At Homebush Bay Drive, the on-ramp would consist of one traffic lane which would provide access to the eastbound mainline tunnel. A lane on the northern side would provide access to the surface M4 eastbound. Both lanes would include a small bridge structure over the proposed re-routed eastbound cycleway, which would travel through an underpass under the on-ramp (instead of on a bridge over the on-ramp, as described in the EIS).

Traffic from the Homebush Bay Drive on-ramp choosing to use the eastbound mainline tunnel would travel in the southern-most (inside) lane, over the cycleway underpass, then on the short bridge described above (over eastbound surface M4 traffic) to merge with traffic travelling from the existing M4 east of Saleyards Creek. The design of the on-ramp widens to two lanes for managed motorway storage, before tapering back to one lane prior to merging with traffic travelling from the existing M4.

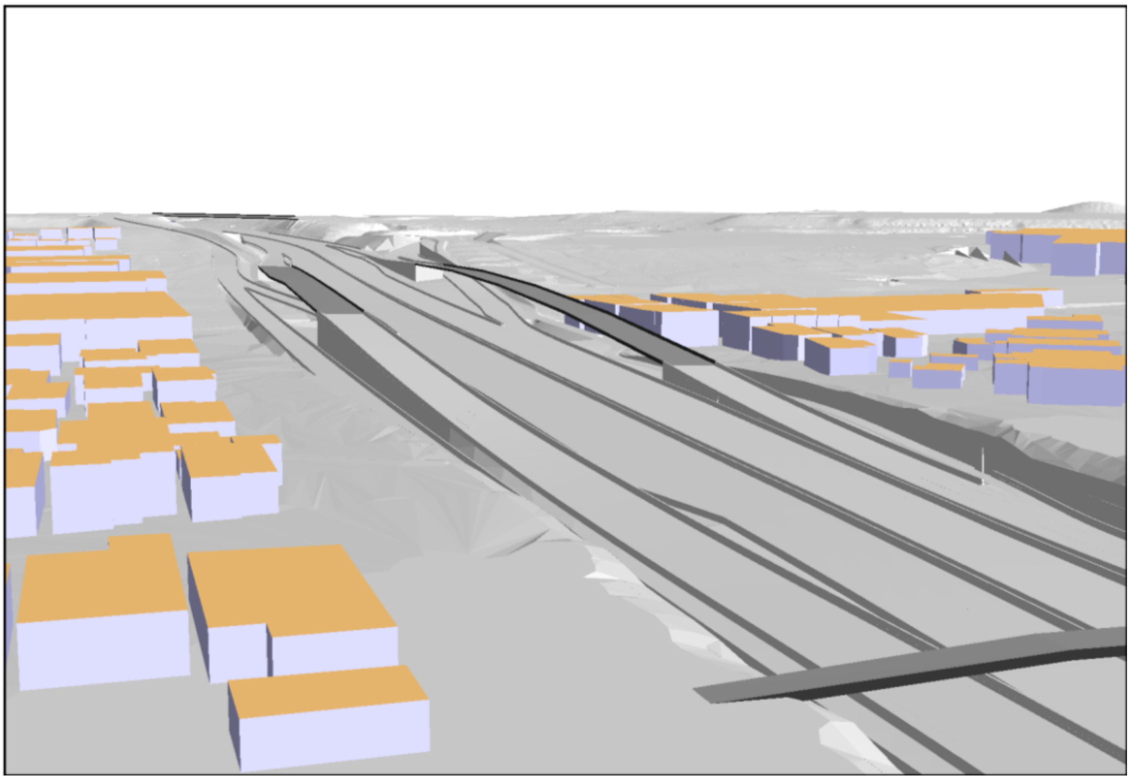

**Figure 2.5 EIS Homebush Bay Drive interchange (oblique elevation, facing west)**

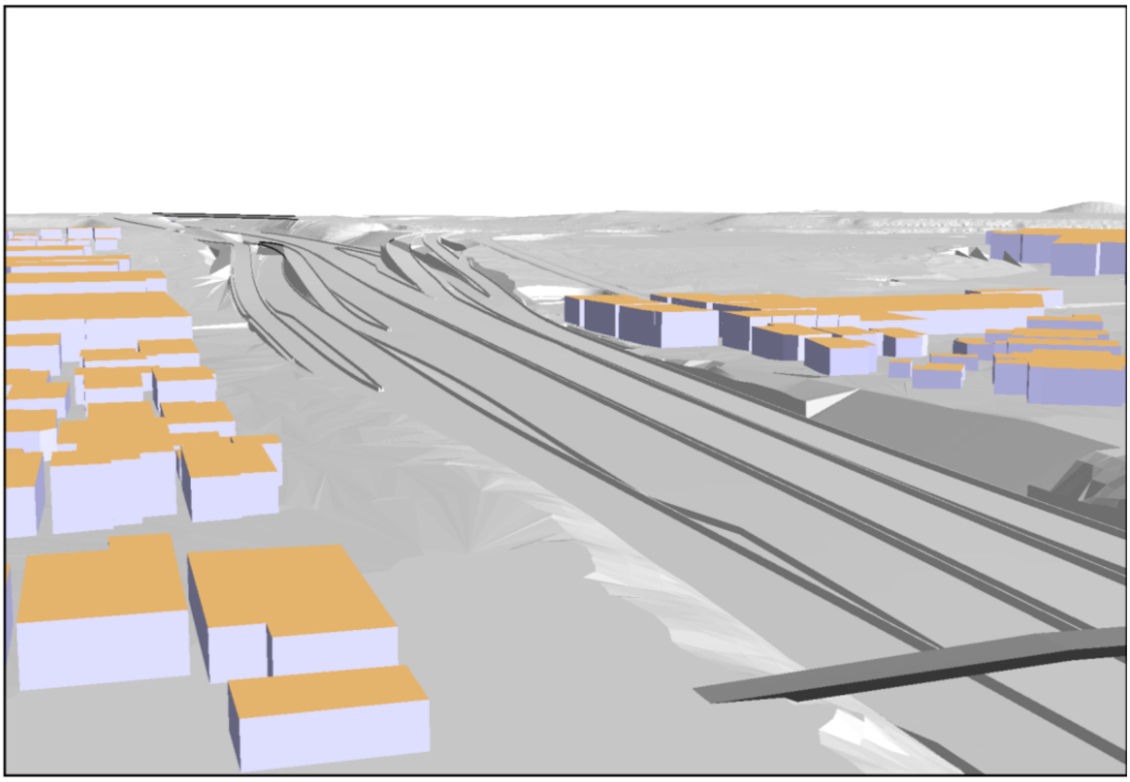

**Figure 2.6 Reconfigured Homebush Bay Drive interchange (oblique elevation, facing west)**


**Figure 2.7 Reconfigured Homebush Bay Drive interchange**

**Figure 2.8** **Indicative view of the revised Homebush Bay Drive interchange, looking east from Homebush Bay Drive. This image is conceptual and is included for illustration purposes only**

Traffic from the Homebush Bay Drive on-ramp choosing to use the surface M4 would travel in the northern-most (outside) lane, over the cycleway underpass. It would then join with the lane from the existing M4 described above, and would travel at grade before connecting to the existing M4 just west of Underwood Road.

### Homebush Bay Drive westbound off-ramp

The westbound off-ramp to Homebush Bay Drive would be realigned to the south and would diverge from the surface M4 just east of Derowie Avenue, which is further to the west than the EIS configuration.

Traffic coming out of the westbound mainline tunnel and choosing to exit at Homebush Bay Drive would use a new exit lane just west of Derowie Avenue, which would travel over Saleyards Creek and a second small bridge structure near Flemington Road, after which it would join the surface M4 to Homebush Bay Drive off-ramp. The two off-ramps would tie into the existing off-ramp about 250 metres east of the signalised intersection with Homebush Bay Drive.

### M4 East tunnel entrance and exit

There would be no changes to the M4 East tunnel entrance and exit portals and the M4 East surface configuration leading to the portals.

### Re-routed eastbound cycleway

The proposed re-routed cycleway would travel under the Homebush Bay Drive on-ramp via an underpass, rather than an overpass as described in the EIS. The off-road section of the re-routed eastbound cycleway has been shortened, and would connect back into the M4 shoulder on the eastbound Homebush Bay Drive on-ramp connection to the surface M4 about 150 metres east of the underpass. The cycleway underpass would be developed further during detailed design.

## 2.2.1 Landscape, visual and urban design specific aspects

The proposed design amendments to the Homebush Bay Drive interchange are extensive and varied. To provide clarity the urban design implications have been assessed in two broad zones; along each of the northern and southern motorway alignments.

### Homebush Bay Drive eastbound on-ramp

The eastbound viaduct that the preferred design proposed adjacent to the residential property between Saleyards Creek and Verley Drive is removed by the proposed design change. This has no influence on project footprint however removes what would have been a significant structural element in the visual environment.

The proposed design change includes a new bridge to perform the lane transfer function of the deleted viaduct. This new eastbound bridge is to be located over the on-ramp from Homebush Bay Drive.

At the eastbound on-ramp, the junction with the Motorway Control Centre access road would be relocated further west by approximately 20 metres, increasing the motorway footprint by the same amount towards the north west (i.e. towards Homebush Bay Drive). This could also provide an additional 20 metres of planting area that could be utilised to provide additional screen planting closer to the motorway.

The proposed design change would be formed at the base of a cut batter adjacent to the Motorway Control Centre, rather than adjacent to a retaining wall formerly incorporated into the preferred design. The resulting operational footprint of this portion of the project is essentially the same however presents a greater degree of ‘cut’ into the existing landform and landscaping than the preferred design, thus reducing the effective space for landscaping and screen planting.

### Re-routed eastbound cycleway

The amended east bound cycleway/shared path from Shirley Strickland Avenue is proposed as an underpass beneath the eastbound on-ramp rather than an over bridge. The western approach to the underpass would be located on a landscaped terrace rather than on the ridgeline of a landscaped embankment as previously proposed. The eastern approach to the underpass is contained partly upon level ground and partly within a cutting rather than on the ridgeline of a landscaped embankment as included in the preferred design.

In the proposed design change, the amended east bound cycleway/shared path from Shirley Strickland Avenue is proposed to merge with the hard shoulder of the eastbound ramp from Homebush Bay Drive to the M4. Cyclists would use the motorway hard shoulder from this point, eliminating this portion of the off road cycle path in the preferred design and potentially contributing to a further reduction of the operational footprint of the motorway away from the residential complex at Verley Drive.

Between Wentworth Road South and the M4 is a reserve that supports a number of mature trees that screen the motorway from the adjacent residential properties. The preferred design located the east bound cycleway/shared path along the southern boundary of the reserve. The proposed design change would transfer that function to the adjacent eastbound hard shoulder. This would potentially reduce the operational project footprint in this zone.

In the preferred design the difference in level between the cycleway/shared path and the M4 between Wentworth Road South and the motorway was to be achieved by locating a retaining wall along this section. The design change instead proposes a batter, which would increase the construction footprint, though retain the operational project footprint in this section.

### Proposed water quality basin

The proposed design change locates a water quality basin between the residential complex off Verley Drive and the hard shoulder of the motorway. This location was formerly taken up with a portion of the cycleway/shared path discussed above, so the construction footprint is approximately the same.

### Homebush Bay Drive westbound off-ramp

The westbound viaduct is removed in the proposed design change. This has no impact on project footprint however removes this proposed structure from the local visual catchment.

A new bridge is proposed to perform the lane transfer function of the deleted viaduct. This new west bound bridge is to be located over the M4 Motorway to M4 Widening entry.

The design change proposes that the westbound off-ramp to Homebush Bay Drive be slightly re-configured and moved to the north. This effectively reduces the footprint along parts of the southern motorway alignment, i.e. west of Bedford Road and east of Kanoona Avenue.

The preferred design made use of a retaining wall to achieve the level change between the M4 and adjacent existing ground. The design change proposes to achieve these levels by introducing a cut batter slope instead of a retaining wall.

### Realignment of M4

The alignment of the M4 adjacent Derowie Avenue and Short Street West is proposed to be re-configured with a similar reduction in the motorway footprint along this section. Effectively the proposed design change adopts the existing condition west of the Pomeroy pedestrian footbridge.

### Noise walls

Additional noise walls are required along the southern alignment between the westbound off-ramp and the noise walls of the preferred design. The proposed noise walls would present as a linear extension of the existing walls.

## 2.3 Description of design change – Sydney Street substation re-orientation

As described in the EIS, the substation at the Concord Road interchange was proposed to be located above the cut-and-cover tunnel on the north-eastern corner of the Concord Lane and Sydney Street intersection, orientated perpendicular to Sydney Street with a frontage along Concord Lane.

Following further design development and in response to issues raised by the community, it is proposed to reorient the substation to run parallel to Sydney Street. The substation would have frontage to Sydney Street, Concord Road and Concord Lane.

The proposed orientation of the substation is shown in **Figure 2.9**, and an indicative view of the re-oriented substation is provided in **Figure 2.10**.


**Figure 2.9 Change in orientation of Sydney Street substation**


**Figure 2.10 Indicative view of the re-oriented Sydney Street substation, looking east. This image is conceptual and is included for illustration purposes only**

### 2.3.1 Landscape, visual and urban design specific aspects

The reoriented substation would have a street address onto Sydney Street, a major thoroughfare, rather than onto Concord Lane. In addition the western end of the building, a blank elevation, would face directly onto Concord Road.

Some minor amendments to setbacks have also resulted, which has provided an increased planter bed width to the Concord Road frontage over that previously proposed for that face of the structure.

The proposed design change would not change the construction or operational footprint of the substation, and the building design is not proposed to be altered.

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# 3 Assessment of impacts

## 3.1 Wattle Street (City West Link) interchange

### 3.1.1 Operational impacts

**Urban design assessment**

The proposed design change would combine the dive and cut and cover structures for both the M4 East ramps and the M4-M5 Link ramps, separating the two M4 East dive structures into two narrower slots west and east of the future M4-M5 Link tunnel.

The overall reduction in the area of cut-and-cover structure will result in a potential net gain of deep soil planting. It is relatively difficult to establish mature, tree plantations above cut-and-cover structures; therefore this amendment would be a net benefit to the project. In addition, the proposed design change presents opportunities for structure/screen planting along each side of each dive structure, which could integrate the twin slots into a single composition.

This revised layout could result in a less visually cohesive arrangement of structures than the original proposal without a well-considered design approach. In particular, the alternate arrangement of cut-and-cover structures over the entry portal has the potential to reduce the former mass planting effect, and future planting design will need to be developed to suit the pockets of restricted landscaping so as to avoid a fragmented appearance.

It is important to provide space along this section of the eastern edge of Wattle Street, to the west of the noise wall, to plant a consistent area of street verge amenity and thereby improve the integration of the motorway within its setting. Detailed design between the footpath and noise wall would need to consider provision of space to enable the continuation of street planting along this section of Wattle Street.

The proposed cul-de-sac at Martin Street would enable a continuation of landscaping which contributes to a consistent band of structure and amenity planting along the eastern boundary of Wattle Street. The adjacent additional RMS-owned property acquisition has the potential to provide an additional area of deep soil screen planting (to be confirmed during detailed design).

The next stage of detailed design will evolve the planting design for this interchange and ensure a landscape outcome which connects adjoining areas of cut and cover structure and deep soils, as well as integrates the landscape potential of the southern motorway verge.

#### Landscape character impact assessment

**Landscape character zone 9 – Dobroyd Parade precinct**

The key effects of the proposed design change on the Dobroyd Parade precinct LCZ would be positive:

- Maintaining or slightly increasing the existing carriageway setbacks and screening to housing on the eastern side of Dobroyd Parade
- Opportunity for provision of three landscape medians and a landscape edge across the frontage of the portal entry, which would assist with the visual integration of the portal, including with the landscape planting behind (south of Ramsay Street)
- The closing of Martin Street immediately east of Wattle Street would assist in reinforcing the generally quiet, residential character of this street.

The potential impacts to the LCZ brought by the proposed design change are broadly similar to those of the preferred design assessed in the EIS. Notwithstanding an increase in roadway width at Ramsay Street compared to that of the preferred design, additional opportunities for landscape integration of the portal area are available through the proposed design change, including the potential for a continuous landscape treatment across the closed end of Martin Street.

The sensitivity of the landscape to change is moderate (consistent with the assessment in the EIS), and within the context of these effects on landscape character of this precinct, the level of impact is still considered to be moderate, unchanged from the EIS. The overall landscape character impact assessment rating therefore remains moderate.

**Landscape character zone 10 – Wattle Street precinct**

The impacts of the project incorporating the proposed design change on the Wattle Street precinct LCZ would be broadly similar to that proposed by the preferred design in the EIS.

Notwithstanding the above described changes in areas cut and cover and deep soil planting, and increased fragmentation of the landscape outcome with this proposal, within the context of overall landscape character impact, the level of impact for this proposal is still considered to be high-moderate, unchanged from the EIS.

## Visibility of the project

### *Receiver location 6 – Reg Coady Reserve near Iron Cove Creek looking west*

The existing view within Reg Coady Reserve near the Iron Cove Creek pedestrian bridge looking south towards Martin Street are as described in the EIS.

The key effects of the proposed design change on this receiver location would be as follows:

- Opportunity for provision of three landscape medians and a landscape edge across the frontage of the portal entry, which would assist with the visual integration of the portal, including with the landscape planting behind (south of Ramsay Street)
- Current screening to housing on the east side of Dobroyd Parade and carriageway setbacks is essentially maintained or slightly increased
- Acquisition of an additional house on the northern side of Martin Street adjoining the proposed works (23 Martin Street), and associated potential for streetscape planting in this location
- Closure of Martin Street and potential for uninterrupted continuation of streetscape planting along Dobroyd Parade from 23 Martin Street (inclusive of the lot) to Ramsay Street
- Removal of a small portion of the two metre footpath setback from the kerb to the east side of Dobroyd Parade between Martin Street and Ramsay Street, with the footpath proposed close to the kerb.

*Lighting*

The amount and impact of lighting and the extent of glare from the project at receiver location 6 will generally be similar with the proposed design change at this interchange, as described previously in the EIS. Project lighting would include cut-off fittings and would be directed to reduce light trespass.

As such, the impacts are likely to remain high and reduce by a minor extent as the proposed landscaping matured.

**Figure 3.1 Existing view from Reg Coady Reserve near Iron Cove Creek looking south.**

**Figure 3.2** **Artist's impression at 12–18 months of operation from Reg Coady Reserve near Iron Cove Creek looking south.**

**Figure 3.3** **Artist's impression at 10 years of operation from Reg Coady Reserve near Iron Cove Creek looking south.**

**Visual impact assessment**

As can be seen from the above, the change in project effects between the preferred design assessed in the EIS and the proposed design change with regard to the view from Reg Coady Reserve is broadly similar. Notwithstanding the increased width of this project at Ramsay Street compared to that within the EIS, the potential for increased landscape along the Wattle Street frontage (east side) in conjunction with the portal medians, should provide an enhanced landscape integration outcome compared with the preferred design as proposed within the EIS, when seen from this receiver location.

There is the potential for some reduction in the extent / density of vegetation that will be seen beyond Ramsay Street due to the above described fragmentation of landscape outcomes from this proposal to that proposed within the EIS. However, overall the level of visual impact for this proposal is still considered to be high-moderate, unchanged from the EIS.

### Existing management measures

The potential impacts of the proposed design change at the Wattle Street interchange can be addressed by the following existing management measure proposed in the EIS (and included in Chapter 8 (Revised environmental management measures) of the Submissions Report):

- V82 - Consider ways to provide pedestrian and streetscape amenity between the noise barriers and the street, and to integrate the area between the back fences of the Walker Street residences and the curving noise barrier.

## 3.2 Homebush Bay Drive re-design

### 3.2.1 Operational impacts

**Urban design assessment**

The proposed design change has the potential to reduce portions of the operational footprint of the project and therefore its physical impact upon the existing setting at the Homebush Bay Drive interchange. As such it represents an improvement on the preferred design assessed in the EIS in line with design commitments made in that report.

*Eastbound on-ramp*

The additional 20 metre length of area immediately east of the eastbound on-ramp junction could be utilised to provide additional screen planting closer to the motorway where it is most needed. The potential for additional planting will also assist in providing a landscape setting for the proposed adjacent shared path. In addition, the rearrangement is expected to provide a more intuitive driver navigation experience.

The next stage of design presents an opportunity to review the planting design and ensure that opportunities for structure street-tree planting are utilised throughout the amended intersection design in order to integrate the proposal within the project setting.

*Rerouted eastbound cycleway*

The proposed underpass for the eastbound cycleway will result in a much improved ‘fit’ within its landscape setting and is an improvement from a visual impact perspective. The underpass is intended as a designated ‘shared path’, and its remoteness could present an associated crime risk for users as there are limited opportunities for natural surveillance. As such, detailed design resolution will be needed to prevent potential crime prevention through environmental design (CPTED) issues that could typically arise with underpasses.

Detailed design of the underpass will be developed in accordance with accepted CPTED design guidelines and include careful attention to details such as lighting, drainage, internal finishes, the elimination of blind corners and entrapment opportunities.

*Shared path merged with the hard shoulder*

Merging the cycleway with the motorway hard shoulder further to the west than the preferred design would reduce the potential width of the motorway, with the potential to provide greater opportunity for landscaping/screen planting. This is of particular relevance to the residential complex off Verley Drive, which would benefit from additional screen planting to the motorway.

The next stage of detailed design will consider in greater detail the pedestrian pathway systems relevant to the project. The evolution of planting and retaining walls design will consider whether additional screen and tree planting can be provided by the proposed design change, to further assist the integration of the project within the local setting.

*Wentworth Road South landscape reserve*

The proposed design change would remove the off-road shared path and retaining walls within the southern portion of the Wentworth Road South landscape reserve, and instead proposes cut slope embankments in this section.

The proposed cut slopes would reduce the area available for landscaping. This loss would be exacerbated by the installation of noise walls along the alignment indicated. However, the proposed design change presents a reduced construction footprint and therefore potentially greater opportunity for landscaping/screen planting around the Motorway Control Centre (MCC). This would benefit adjacent residential properties adjacent to the motorway.

The next stage of design will consider ways to optimise opportunities for screen and tree planting, to integrate the project within the surrounding landscape. The proposed location of noise walls will also be reviewed in order to minimise impacts upon existing vegetation, where practicable.

*Motorway Control Centre*

The proposed design changes are contained within a reduced area compared with the preferred design assessed in the EIS, and presents a reduced construction footprint and therefore potentially greater opportunity for landscaping/screen planting around the MCC, however the proposed design change removes the retaining walls between the MCC and the M4 eastbound on-ramp and replaces these with an engineered cut embankment. This change is likely to reduce the effectiveness of landscaping and screen planting in this section.

The next stage of design will consider ways to optimise opportunities for screen and tree planting, and to better integrate the project within the surrounding landscape.

*Water quality basin*

A water quality basin is proposed between the east bound on-ramp, in place of the previously proposed shared pathway.

The next stage of design will further refine the water quality basin in order to optimise opportunities for effective visual screening between the adjoining residential units and the motorway.

*Eastbound on-ramp*

The at-grade carriageway ‘bridge’ behind a noise wall proposed in the design to replace the 300 metre long, 10 metre high viaduct proposed by the preferred design change represents a significant improvement in the design of this section of the project by removing an elevated structure within close proximity to adjacent residential dwellings.

The next stage of design will consider the detailed integration of noise and retaining walls in this section of the project and look to optimise opportunities for screen and tree planting. The design should also consider the need to minimise light spill into the adjacent residential complex off Verley Drive, although this should be improved by the design change which removes the elevated section of the on-ramp down to the existing motorway level.

The proposed new bridge at the eastbound on-ramp will be less than 40 metres long. Although designed as a bridge, this structure would actually appear and perform as an underpass with little or no visual impact as an elevated structure. It will negate the need for the 300 metre long viaduct discussed above and is a significant improvement to the visual prominence of the project.

The next stage of design will consider the detailed integration of the bridge with its various urban design components and adjacent elements of retaining walls, lighting crash barriers (for example) to develop a fully integrated design.

*Westbound off-ramp*

The realignment of the westbound off-ramp would benefit the project by reducing the potential impact on existing landscape features and by providing more space for potential screen planting.

The next stage of design will review the planting design and ensure that opportunities for structure street-tree planting are utilised throughout the amended intersection design, to further integrate the proposal within the project setting.

Removal of proposed retaining walls at the westbound off-ramp and replacement with cut batters could reduce the effective benefit of additional screen planting.

The next stage of design will review the planting and retaining wall design ensuring that opportunities for structure street-tree planting are fully utilised throughout the amended intersection design, to further integrate the project within the local setting.

### *Realignment of M4*

This design change would reduce the potential impact on existing landscape features and provide more space for potential screen planting.

The next stage of design will review the planting design to ensure that opportunities for structure screen and street-tree planting are utilised, to further integrate the project within the local setting.

The proposed deletion of the 230 metre long, nine metre high westbound viaduct proposed as part of the preferred design with an approximately 70 metre long bridge structure will be a significant improvement to this section of the project. Although designed as a bridge, this structure will actually appear as an underpass structure with little or no visual impact as an elevated structure.

The next stage of design will consider the detailed integration of the bridge with its various urban design components and adjacent elements of retaining walls, lighting, crash barriers (for example) in order to realise a fully integrated design and consider opportunities for screen and tree planting within the motorway corridor.

### *Noise walls*

The proposed design changes include additional noise walls, the alignment of which would adopt that of those included in the preferred design. Where the proposed walls are additional to the already proposed noise walls, they would be seen as a linear extension of the existing walls and therefore are appropriately located.

The next stage of design will ensure that the detailed design, materiality and colour of noise walls are in accordance with the relevant RMS design guidelines. In particular the noise walls will be robust enough to be located in close proximity to tree and screen planting without compromise to their structure and finishes.

## Landscape character impact assessment

The following four landscape character zones are relevant to assess impacts on landscape character arising from the proposed design changes:

- Landscape character zone 1 – M4 Motorway
- Landscape character zone 2 – Homebush commercial precinct
- Landscape character zone 3 – Parramatta Road (west) precinct

- Landscape character zone 4 – Underwood Road precinct

The landscape character zones east of these areas are sufficiently removed from the proposed changes to warrant re-assessment.

**Landscape character zone 1 – M4 Motorway**

The sensitivity of the landscape to change is considered to be moderate, consistent with the EIS. The change in project effects between the preferred design assessed in the EIS and the proposed design changes with regard to the Homebush Bay Drive precinct landscape character zone are broadly similar, with regard to landscape character.

Key beneficial design changes for this project over that within the EIS comprise:

- Removal of the long viaducts broadly located adjacent to Verley Drive, and their replacement with lower scale bridges
- Increased opportunities for corridor edge landscape structure planting including that associated with the MCC; increased retention of existing structure planting along the southern edge of the motorway, including sections of Park Road, and re-configured west bound exit ramp to Homebush Bay Drive which potentially provides increased planting opportunities.

Notwithstanding these generally beneficial changes, within the context of overall landscape character impact, the level of impact for this section of the project is still considered to be high-moderate, unchanged from the EIS.

**Landscape character zone 2 – Homebush commercial precinct**

**Project effects**

The width of the open space between the Homebush Bay Drive on-ramp and the adjacent car park and electrical substation would be reduced, however as the remaining open space contains moderate screen tree planting that has the opportunity for additional planting, it can be expected that the visual character of this zone would remain broadly intact as a result of the project. While it is likely that the proposed maintenance facility and motorway control centre buildings would be partially visible from this location, these are of well-considered design and are in context visually with the built form of the warehouse/commercial premises within this LCZ.

**Landscape character assessment**

The sensitivity of the landscape to change is considered to be low, consistent with the EIS.

With regard to an assessment of landscape character impacts on the Homebush commercial precinct, the change in project effects between the EIS and the proposed design changes are broadly similar. Within this context the level of impact for this proposal is still considered to be low, unchanged from the EIS.

**Landscape character zone 3 – Parramatta Road (west) precinct**

**Project effects**

The Parramatta Road (west) precinct LCZ currently contains a substantial vegetated edge to the M4 along most of its length ranging between about 10 and 30 metres in width, with the exception of the M4 bridge crossing of Powells Creek and the Northern Rail Line. Most of this screening vegetation falls within the M4 corridor. Key effects of the proposed design changes on vegetation in this LCZ comprise:

- With regard to the light industrial component of this LCZ:
- Existing screening vegetation would be removed at the western end of Park Road due to the incorporation of new batters.

**Landscape character assessment**

The sensitivity of the landscape to change is considered to be moderate, consistent with the EIS.

With regard to an assessment of landscape character impacts on the Parramatta Road (west) precinct, the change in project effects between the EIS and the proposed design changes are broadly similar. This change provides the following improvements over the design considered within the EIS:

- Re-configured west bound exit ramp to Homebush Bay Drive with improved planting opportunities
- Realignment of the M4 with increased opportunities for retention of existing screening vegetation
- Tightening up of the motorway design along the Park Road frontage to provide additional opportunities for landscape structure planting at either end of Park Road.

However, the elimination of retaining walls associated with the westbound off-ramp will reduce landscape structure planting opportunities.

Notwithstanding the above, the level of impact for this proposal is still considered to be moderate, unchanged from the EIS.

**Landscape character zone 4 – Underwood Road precinct**

**Project effects**

Generally, the potential visual impacts of the project in this LCZ would be limited to the edge of adjoining residential land uses.

The project effects of the proposed design changes on the Underwood Road precinct would be generally similar to that described in the EIS.

**Landscape character assessment**

The sensitivity of the landscape to change is considered to be moderate, consistent with the EIS.

With regard to an assessment of landscape character impacts on the Underwood Road precinct, the change in project effects between the EIS and the proposed design changes are broadly similar. Notwithstanding the improved outcome of removing a 300 metre long, 10 metre high viaduct adjacent to Verley Drive, the level of impact for this proposal is still considered to be moderate, unchanged from the EIS.

### Visibility of the project

*Receiver location 1 – M4 east of Homebush Drive*

The foreground view from this location would encompass six M4 eastbound and westbound mainline lanes, with an Homebush Bay Drive off-take rising ramp and associated bridge structure to right of frame, and beyond this from Park Road. To left of frame, the foreground view from this location would encompass a Homebush Bay Drive descending ramp merging with the eastbound mainline lanes. The background view would comprise the existing retained Park Road pedestrian bridge with entry and exit portals beyond, and the M4 Motorway eastbound surface lanes with North Strathfield in the background to left of frame beyond this.

The width of the carriageway corridor at this point of the project is similar to the design assessed in the EIS (refer to **Figure 2.5** and **Figure 2.6)**.

Noise walls are proposed east of this location, ranging between about three metres to six metres high along the M4 Motorway northern boundary.

Similar to the preferred design as assessed in the EIS, the extent of landscape screening along the outside edges of the M4 Motorway would be reduced. Potential may exist for the planting of relatively narrow bands of trees between the carriageway and the motorway control centre, workshop and bulk equipment store to the north, and between lanes within the carriageway (refer to **Figure 2.8**).

*Lighting*

The amount and impact of lighting and the extent of glare from the project at this location will generally be similar with the preferred design at this interchange, as described previously in the EIS. Project lighting would include cut-off fittings and would be directed to reduce light trespass.

As such, the impacts are likely to remain moderate.

**Figure 3.4 Current view from the M4 east of Homebush Bay Drive looking east.**

**Figure 3.5 Artist's impression at 10 years of operation from M4 east of Homebush Bay Drive looking east.**

**Figure 3.6 Artist's impression from the M4 east of Homebush Bay Drive looking east**

*Visual impact assessment*

**Table 3.1 Receiver location 1 visual impact assessment**

| Receiver | Sensitivity and magnitude | Overall visual impact assessment |
|---|---|---|
| Motorists | The sensitivity of motorists to change is considered to be low, within the context that:<br>• Most users of this major transport route will be engaged in commuting associated with their work, or other travel where the travel experience is associated with that of a necessary functional means of quickly getting to their destination<br>• Notwithstanding the change in the character of the motorway from that of a visually homogeneous, well vegetated corridor to that of a predominantly hard landscape, this will be subject to a well-considered architectural and urban design process during the design development phase<br>• The duration of the view will be relatively fleeting, with the receiver either having been passing through a well vegetated corridor for much of their journey when travelling from the west, with this section of hard landscape comprising a relatively fleeting transition zone to that of the M4 tunnel.<br>The magnitude of change from the existing situation is still considered to be moderate within the context that the project is broadly an upgrading of an existing motorway, but that the form of that motorway will change from a relatively narrow (four lanes plus entry and exit lanes), simple one that is predominantly tightly visually enclosed by cut batters and dense vegetation, to one that is up to 14 lanes wide with bridging structures, tunnel portals and limited soft landscape integration. | This provides an overall visual impact assessment rating of moderate–low. |

**Comparison of designs**

As can be seen from the above, the change in project effects between the EIS proposal and this proposal with regard to the view from the M4 Motorway is broadly similar. Notwithstanding that the revised design has some benefits over that within the EIS such as:

- potential for an increased level of structure planting at the MCC
- elimination of the long and high viaducts/bridge crossing adjacent to Verley Drive
- likely retention of existing trees to the southern edge of the M4 Motorway east of the Park Road pedestrian bridge.

Conversely there is the potential for reduction in the extent / density of vegetation that will be seen between Verley Drive and Bill Boyce Reserve, and adjoining the west bound exist ramp.

However, overall the level of visual impact for this proposal is still considered to be moderate to low, unchanged from the EIS.

## Existing management measures

The potential lighting impacts of the proposed Homebush Bay Drive redesign on the residents of Verley Street can be addressed by the following existing management measure proposed in the EIS (and included in Chapter 8 (Revised environmental management measures) of the Submissions Report):

- V52 - Consider at-receiver planting to reduce visual and lighting impacts on residential receivers.

## 3.3 Sydney Street substation re-orientation

### 3.3.1 Operational impacts

**Urban design**

The proposed design amendment to the Sydney Street sub-station involves a 90 degree re-orientation of the building from a north-south alignment along Concord Lane to an East West alignment along Sydney Street.

In the preferred design assessed in the EIS, the western, 'front' elevation would have faced onto Concord Lane, a relatively minor laneway. As a relatively 'public face' this elevation was to have been architecturally detailed with ceramic tile finishes, to a reasonably high standard. On the other hand the 'rear', eastern elevation, would have received a basic level of painted/rendered blockwork finish. This 'rear' elevation would have directly impacted upon multiple future development lots between the substation and Concord Road. Until such time as these lots are developed this 'rear' elevation would have been highly exposed to the busy Concord Road - therefore a highly visible, but relatively utilitarian painted/rendered blockwork finish.

The proposed design change would place the 'front' elevation to the more public Sydney Street – a more appropriate street address. The substation would be set back four metres from the Sydney Street kerb-line, which would be similar in alignment with the likely building face of future development along Sydney Street to the west – therefore respecting the continuation of the existing 'street wall'.

The blank 'rear' elevation would face directly towards the likely future residential lots to the north, but would only directly impact upon one lot, compared to multiple lots of the previous design.

The blank, western elevation of the substation would face into Concord Lane, thereby adopting the likely typology of future residential lots in the adjacent residual land to the west – which is appropriate for this context.

The blank, eastern elevation would face directly onto Concord Road, and would align with the typology likely to be adopted by future residential lots in the adjacent residual land immediately to the north. The front face of this elevation would be generally aligned with the face of the future development to the north, thereby respecting the future 'street wall'.

It is notable that this eastern elevation would be of a similar width to the likely future residential lots to the north – therefore even though it is a blank elevation it would adopt a similar scale and rhythm to those lots. In addition there would sufficient space to provide a landscape buffer along the eastern elevation.

This proposed design change would improve the preferred design and therefore be of benefit to the project. The next stage of design will consider in detail:

- The placement of the sub-station, relative to its lot boundaries and necessary set-backs (with particular attention to the setbacks of future adjacent development), in order to provide the largest possible landscape screening, minimum hard standing zone, for future maintenance access, minimising disruption to traffic and pedestrian movements
- The careful placement of street trees along Sydney Street frontage in order to not be compromised by future maintenance vehicle movements
- A detailed landscape design for all building frontages that respond to the varied street conditions of each – with particular attention to achieving the optimum set-back and buffer zone between Concord Road and the south-eastern building elevation
- Building finishes for all elevations.

## Landscape character impact assessment

### Landscape character zone 6 – Concord Road precinct

### Project effects

The key project effects of the proposed design change on the Concord Road precinct LCZ would be:

- Realignment of the proposed Sydney Street substation (about 32 metres long by 8 metres wide by 5 metres high), comprising a block form 'infrastructure' element, facing onto Sydney Street, and reduced visual prominents to northbound traffic on Concord Road (further reduced through the planting of street trees in front, and any landscaping within the building frontage). If the residual land on Concord Road is utilised for housing, the locating of this building along the street frontage has the potential to comprise a visually contrasting element within the residential setting (dependent on capacity to incorporate street trees and frontage landscaping), though one which adopts a similar scale and rhythm to those lots
- Increased opportunity for landscape integration planting at the eastern end of the building facing onto Concord Road, over that provided for the same end wall in the EIS, from approximately 1.7 metres wide to a width of approximately 2.9 metres
- The building may comprise a visually contrasting element within the context of the Cheil Church opposite, however as noted above, there is increased opportunity for landscape integration planting at the eastern end of the building facing onto Concord Road. The extent of this visual contrast would be dependent upon the responsiveness of the design of built form within the adjoining future development area
- Due to the fall of the land at this corner the long building has the potential to sit relatively high at the corner Sydney Road West and Concord Lane, though the extent of the building that this relates to is reduced in comparison to the preferred design assessed in the EIS.

### Landscape character assessment

As outlined in the EIS, the sensitivity of the landscape to change is considered to be low within the context of the existing busy road environment, existing entropy effects and proximity to the M4. With regard to an assessment of landscape character impacts on the Concord Road precinct, the change in project effects between the preferred design and the proposed design change are similar within an overall context, but considerably different in detail with regard to the re-alignment of the substation. From the perspective of visual impact, the revised substation realignment is seen to have a lesser visual impact than that provided within the EIS.

However, within an overall landscape character context, the level of impact for this proposal is still considered to be moderate, unchanged from the EIS.

Visibility of the project

As there was no visual receiver location assessed that incorporated the substation, a formal visual impact assessment has not been undertaken for this element.

## Existing management measures

The potential lighting impacts of the proposed Sydney Street substation re-orientation can be addressed by the following existing management measures proposed in the EIS (and included in Chapter 8 (Revised environmental management measures of the Submissions Report):

- V29 - Refine substation designs during pre-construction to be integrated as far as possible within each landscape and urban context.
- NAH17 - Where feasible, the size and form of the proposed distribution substation to be located near the corner of Sydney Street and Concord Road will be designed to be as recessive as possible and incorporate sensitive landscaping treatment to reduce permanent visual impacts on the remaining portion of Powells Estate Conservation Area (somewhat effective).

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# 4 Additional management measures

No additional measures are recommended.

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# 5 Conclusion

## 5.1 Urban Design

This assessment has compared the proposed urban design amendments with the original design in order to ensure that they respond to the SEARs requirements; and also that the changes would improve or benefit the M4 East project. The following objectives have also been considered:

- The proposed amendment should enhance the motorway interchanges, tunnels, cut-and-cover and ‘slot’ arrangements in line with the objectives and principles of the WestConnex Urban Design Framework
- The proposed amendment should consider the future potential of residual land
- The proposed amendment should enhance hard and soft urban design elements of the project, and be consistent with the existing and desired future character of the area
- The proposed amendment should respond to the visual amenity implications upon the surrounding area, in terms of both impacts and potential impact mitigation.

This Urban Design assessment has considered the proposed changes to 3 areas, the section of the M4 East between Homebush Bay Drive and Concord Road; the Wattle Street precinct; and the distribution substation at Sydney Street. The design changes range from the deletion of two major viaducts to minor realignments of carriageway, all of these proposed changes occur largely within the current project footprint.

Throughout the assessment has been mindful of the guiding vision of the WestConnex Urban Design Framework that:

> *The WestConnex motorway shall be a sustainable, high quality and transformational project for the people of Sydney and NSW. Exhibiting design excellence as a whole and in all constituent parts, it should be sensitively integrated into the natural and built environment, help build communities and contribute to the future liveability of the city (WUDF p.44).*

While the transformational potential of the project is likely to depend upon the delivery of the whole WestConnex program, that success would be founded on the quality of its constituent parts, including the M4 East project. This assessment has therefore been particularly mindful of the design objectives, and of the need for sensitive integration within the project setting, and the impact of that upon communities and liveability.

None of the proposed urban design amendments impacts upon the connectivity objectives regarding Parramatta Road.

The proposed amendment to the orientation of the sub-station on Sydney Street has a beneficial influence on the potential future uses of adjacent residual lands as well as streetscape amenity. None of the other proposed urban design amendments has an influence upon residual lands.

Consideration is needed during detailed design to provide space to enable a consistent area of street verge amenity along this section of the eastern edge of Wattle Street, and thereby improve the integration of the motorway within its setting.

This assessment has found that the proposed urban design amendments are generally consistent with the objectives and design principles set by the WestConnex Urban Design Framework. Where exceptions exist it is generally due to the lack of detailed design resolution rather than inappropriate design. Further design resolution is required in order to resolve to these exceptions.

For example, the proposed design changes do not include landscape design amendments. It is therefore difficult to assess the amendments against the Roads and Maritime design guidelines – in particular the *‘Beyond the Pavement, Urban Design Policy Procedures and Design Principles’* (RMS 2014), the NSW guiding document for motorway urban design. Therefore this assessment has made assumptions as to the likely landscape outcomes, and required these elements to be developed as integral with the proposed amendments.

On the basis of these assessment recommendations the proposed amendments are supported.

## 5.2 Landscape character and visual impacts

Key landscape character and visual amenity issues arising from the assessment include a loss of a substantial corridor of vegetative screening to the existing M4, and change in character of the motorway to a much wider hardscape development that provides limited opportunities for landscape integration between the carriageways and along parts of the boundary. Within the context, the design and execution of the urban design associated with the project works will be critical to the visual outcomes of the project.

Additionally opportunities should be explored for increased outcomes in this regard, for example:

- Considering design developments which facilitate increased opportunities for well anchored, substantial tree planting
- Consideration of changes to the project design to facilitate better landscape integration and amenity outcomes for adjoining sensitive visual receivers, eg relocation of the proposed WQCP between the M4 Motorway and the Verley Drive apartments to facilitate landscape integration along this edge.

Further, design and execution of the urban design will need to focus on:

- Design refinement of the Wattle Street southern frontage west of Ramsay Street to minimise fragmentation of the proposed landscape design compared with that in the EIS
- Sydney Street West in response to the proposed realignment of the substation.

# Appendix G

## Non-Aboriginal heritage assessment of design changes

WestConnex

# Roads and Maritime Services

WestConnex M4 East

Heritage Impact assessment of design changes

December 2015

**Prepared for**

Roads and Maritime Services

**Prepared by**

*AECOM Australia*

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# Contents

# Glossary of terms and abbreviations

| | |
|---|---|
| AA | Archaeological Assessment |
| AJC | Australian Jockey Club |
| CBD | Central business district |
| CCTV | Closed Circuit Television |
| CHL | Commonwealth Heritage List |
| CMP | Conservation Management Plan |
| Contributory item | Place within a Heritage Conservation Area that contributes to its heritage significance |
| DCP | Development Control Plan |
| DMR | Department of Main Roads (now Roads and Maritime Services) |
| DP&E | NSW Department of Planning and Environment |
| EIS | Environmental Impact Statement |
| EP&A Act | *Environmental Planning & Assessment Act 1979* (NSW) |
| GML | GML Heritage Pty Ltd |
| HAMU | Historical Archaeological Management Units |
| HCA | Heritage Conservation Area |
| Heritage Act | *Heritage Act 1977* (NSW) |
| Heritage Council | Heritage Council of NSW |
| Heritage Division | NSW Heritage Division, Office of Environment and Heritage |
| Heritage item | Place listed on a statutory heritage register |
| HIA/HIS | Heritage Impact Assessment/Heritage Impact Statement |
| Intrusive item | Place within a Heritage Conservation Area that detracts from its heritage significance |
| ITS | Intelligent Transport System |
| LEP | Local Environmental Plan |
| LGA | Local Government Area |
| M4 East | WestConnex M4 East Motorway |
| National Trust Register | Register of the National Trust of Australia (NSW) |
| Neutral item | Place within a Heritage Conservation Area that does not contribute to or detract from its heritage significance |
| OEH | NSW Office of Environment and Heritage |
| Potential heritage item | Place identified in this report as potentially having heritage significance, which is not recognised on a heritage register |
| Roads and Maritime | Roads and Maritime Services |
| RTA | Roads and Traffic Authority (now Roads and Maritime Services) |
| Section 170 Register | State Agency Section 170 Heritage and Conservation Register |
| SEARs | Secretary's Environmental Assessment Requirements |
| SHR | State Heritage Register |
| SSI | State Significant Infrastructure |
| VMS | Variable Message Sign |
| WDA | WestConnex Delivery Authority |

# 1 Introduction

## 1.1 Overview of the project

Sydney Motorway Corporation (SMC), on behalf of the NSW Roads and Maritime Services (Roads and Maritime), is seeking approval to upgrade and extend the M4 Motorway from Homebush Bay Drive at Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield, in inner western Sydney. These proposed works are described as the M4 East project (the project).

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). The project was declared by the Minister for Planning to be State significant infrastructure and critical State significant infrastructure and an environmental impact statement (EIS) was therefore required.

An EIS was prepared for the project and was submitted in September 2015. The EIS and the associated specialist studies were then placed on public exhibition for a 55 day period, during which time the community and stakeholders were invited to make comments on the project and the EIS.

The project is a component of WestConnex, which is a proposal to provide a 33 kilometre motorway linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct. The location of WestConnex is shown in **Figure 1.1** The individual components of WestConnex are:

- M4 Widening – Pitt Street at Parramatta to Homebush Bay Drive (planning approval granted and under construction)
- M4 East (the subject of this report)
- New M5 – King Georges Road at Beverly Hills to St Peters (EIS currently on public display)
- King Georges Road Interchange Upgrade (planning approval granted)
- M4–M5 Link – Haberfield to St Peters, including the Southern Gateway and Southern Extension (undergoing concept development).


**Figure 1.1** **WestConnex**

Separate planning applications will be lodged for each individual component project. Each project will be assessed separately, but the impacts of each project will also be considered in the context of the wider WestConnex.

The NSW Government initially established the WestConnex Delivery Authority (WDA) to deliver WestConnex. WDA was established as an independent public subsidiary corporation of Roads and Maritime and was project managing the planning approval process for the project on its behalf.

Since June 2015, the project delivery functions of WDA have been under transfer to SMC, following a decision to evolve WestConnex governance into a single decision-making entity. The transfer of functions was completed on 30 September 2015.

SMC is a corporation established under the *Corporations Act 2001* (Commonwealth) with a majority independent board of nine directors. The NSW Roads Minister and NSW Treasurer are joint shareholders. It is a public financial enterprise established by regulation.

Notwithstanding this, for the purpose of the planning application for the M4 East project, Roads and Maritime is the proponent.

## 1.2 Project location

The project is located in the inner west region of Sydney within the Auburn, Strathfield, Canada Bay, Burwood and Ashfield local government areas (LGAs). The project travels through 10 suburbs: Sydney Olympic Park, Homebush West, Homebush, North Strathfield, Strathfield, Concord, Burwood, Croydon, Ashfield and Haberfield. The location of the project is shown in **Figure 1.2.**

The project is generally located within the M4 and Parramatta Road corridor, which links Broadway at the southern end of the Sydney central business district (CBD) and Parramatta in Sydney's west, about 20 kilometres to the west of the Sydney CBD. This corridor also provides the key link between the Sydney CBD and areas further west of Parramatta (such as Penrith and western NSW).

The western end of the project is located at the interchange between Homebush Bay Drive and the M4, about 13 kilometres west of the Sydney CBD. The project at this location would tie in with the M4 Widening project in the vicinity of Homebush Bay Drive. The tunnels which form part of the project would dive from the centre of the M4, west of the existing pedestrian footbridge over the M4 at Pomeroy Street, and would continue under the northern side of the existing M4 and Parramatta Road, before crossing beneath Parramatta Road at Broughton Street, Burwood. The tunnels would under the southern side of Parramatta Road until the intersection of Parramatta Road and Wattle Street at Haberfield. Ramps would connect the tunnels to Parramatta Road and Wattle Street (City West Link) at the eastern end of the project. The tunnels would end in a stub connection to the possible future M4–M5 Link (which is subject to planning approval), near Alt Street.

The project would include interchanges between the tunnels and the above ground road network, along with other surface road works, at the following locations:

- M4 and Homebush Bay Drive interchange at Sydney Olympic Park and Homebush
- Powells Creek, near George Street at North Strathfield
- Queen Street, near Parramatta Road at North Strathfield
- M4 and Sydney Street, Concord Road and Parramatta Road interchange at North Strathfield
- Wattle Street (City West Link), between Parramatta Road and Waratah Street at Haberfield
- Parramatta Road, between Bland Street and Orpington Street at Ashfield and Haberfield.

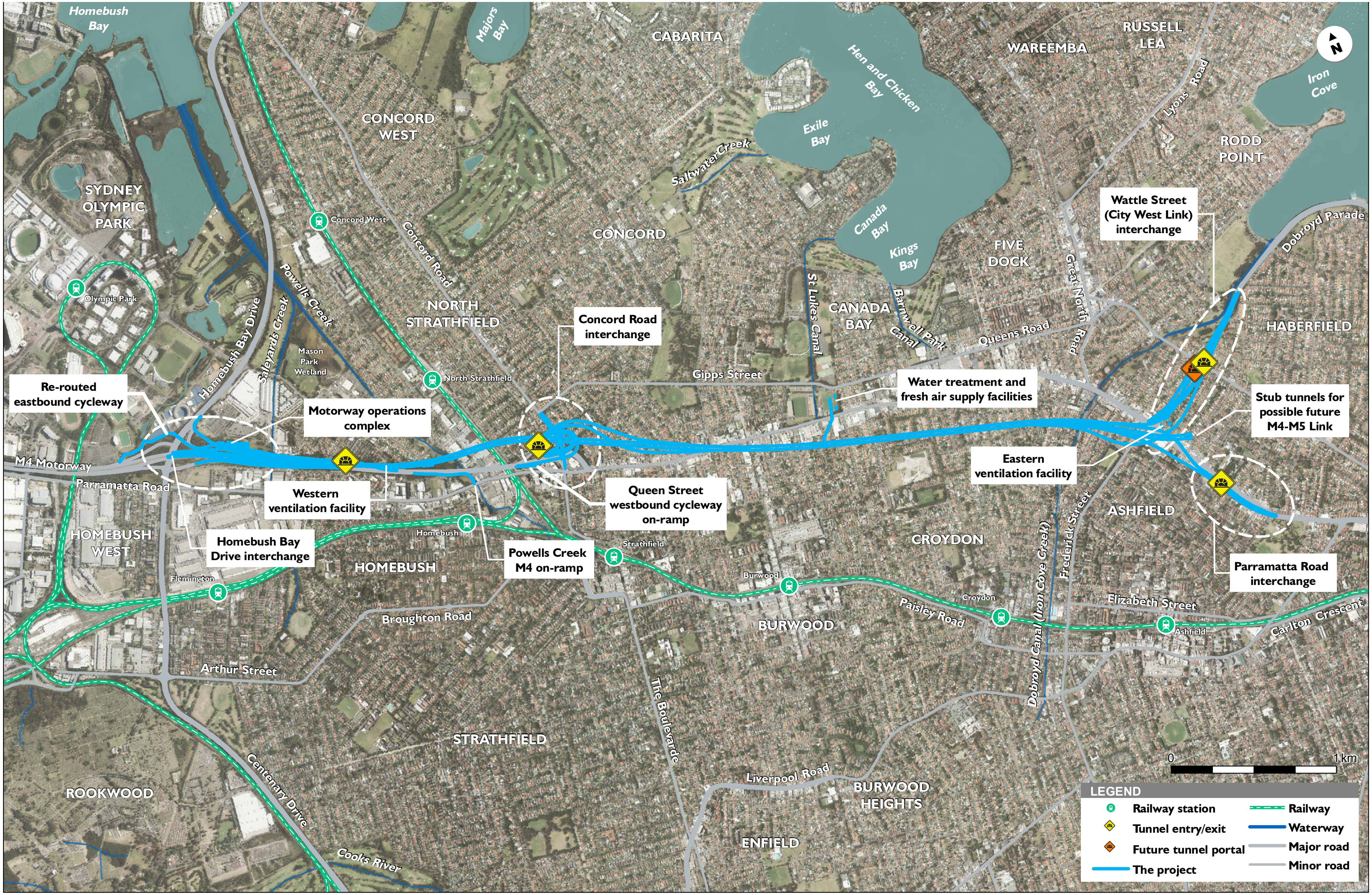


**Figure 1.2 Project location**

## 1.3 Purpose of this report

This report has been prepared to outline and assess the impact of alternative design options that have been identified since the exhibition of the EIS. As outlined in section 5.1 of the EIS, the project description was based on the preliminary concept design and will be refined during detailed design. The EIS notes that the final design of the M4 East project that is built could therefore vary from its description in the EIS.

This report assesses the Non-Aboriginal heritage impacts of the alternative design options, as described in **section 2**.

## 1.4 Assessment methodology

This report has been prepared in accordance with the Assessment Methodology identified in Section 3 of Appendix S of the EIS - Non-Aboriginal Heritage Impact Assessment.

The main aspects of the design changes which have been assessed in this report include:

- Re-orientation of the Sydney Street sub-station at North Strathfield
- Changes to the Wattle street interchange design in Haberfield.

The assessment has been carried out generally in accordance with the approach adopted in the following sections of Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment:

- Section 6.5 – Area 2 North Strathfield and Concord
- Section 6.7 – Area 4 Haberfield and Ashfield
- Appendix A – Potential Heritage Items.

# 2 Proposed design changes

## 2.1 Wattle Street (City West Link) interchange

In the EIS, the Wattle Street (City West Link) interchange included separate cut and cover tunnel structures..

As a result of ongoing design development, the configuration of the Wattle Street interchange is proposed to be modified. The purpose of these changes is to combine the dive and cut and cover structures for both the M4 East ramps and the M4-M5 Link ramps.

The proposal will result in the acquisition and demolition of the freestanding residence at 23 Martin Street.

The below sections outline the proposed changes to the configuration of the interchange. The new arrangement is shown in plan view in **Figure 2.1. Figure 2.2** shows the original configuration in oblique view and **Figure 2.3** shows the revised configuration in oblique view.

### M4 East tunnel exit to Wattle Street

The M4 East tunnel exit to Wattle Street would not be altered significantly. The tunnel portal would remain on the northern side of Ramsay Street.

The dedicated right turn bay at the Waratah Street signalised intersection would remain for traffic exiting the eastbound mainline tunnel only.

### M4 East tunnel entrance from Wattle Street

The M4 East tunnel entry from Wattle Street would be relocated further to the east, so that the on-ramp would be the eastern-most (kerbside) lane while the surface Wattle Street would continue in the centre lanes. The dive structure for this on-ramp would start on the southern side of Martin Street. The tunnel portal would remain on the northern side of Ramsay Street.

There would be no other change to the on-ramp.

### Wattle Street surface adjustments

The surface Wattle Street eastbound lanes would not change as part of the modification of the interchange.

The surface Wattle Street westbound lanes would be realigned to the east of its existing alignment; however, it would continue in the centre lanes (instead of the kerbside lanes as described in the EIS). To do this, the surface lanes would travel over the cut and cover sections of the M4–M5 Link on- and off-ramps.

South of Ramsay Street, the westbound surface Wattle Street lanes would still split as described in the EIS, two separate sets of lanes providing access to Parramatta Road westbound, and Parramatta Road eastbound or Frederick Street southbound.

North of Waratah Street, the surface works would remain on the same general alignment.

### M4–M5 Link on- and off-ramps tunnels

The M4-M5 Link cut and cover structures would start in about the same location as described in the EIS, but would be realigned so that they are positioned between the M4 East on- and off-ramps. The on- ramp dive structure would be lengthened, while the off-ramp dive structure would be shortened.

### Martin Street intersection works

A cul-de-sac would be established at Martin Street abutting the eastern side of the project.


**Figure 2.1 Reconfigured Wattle Street (City West Link) interchange**

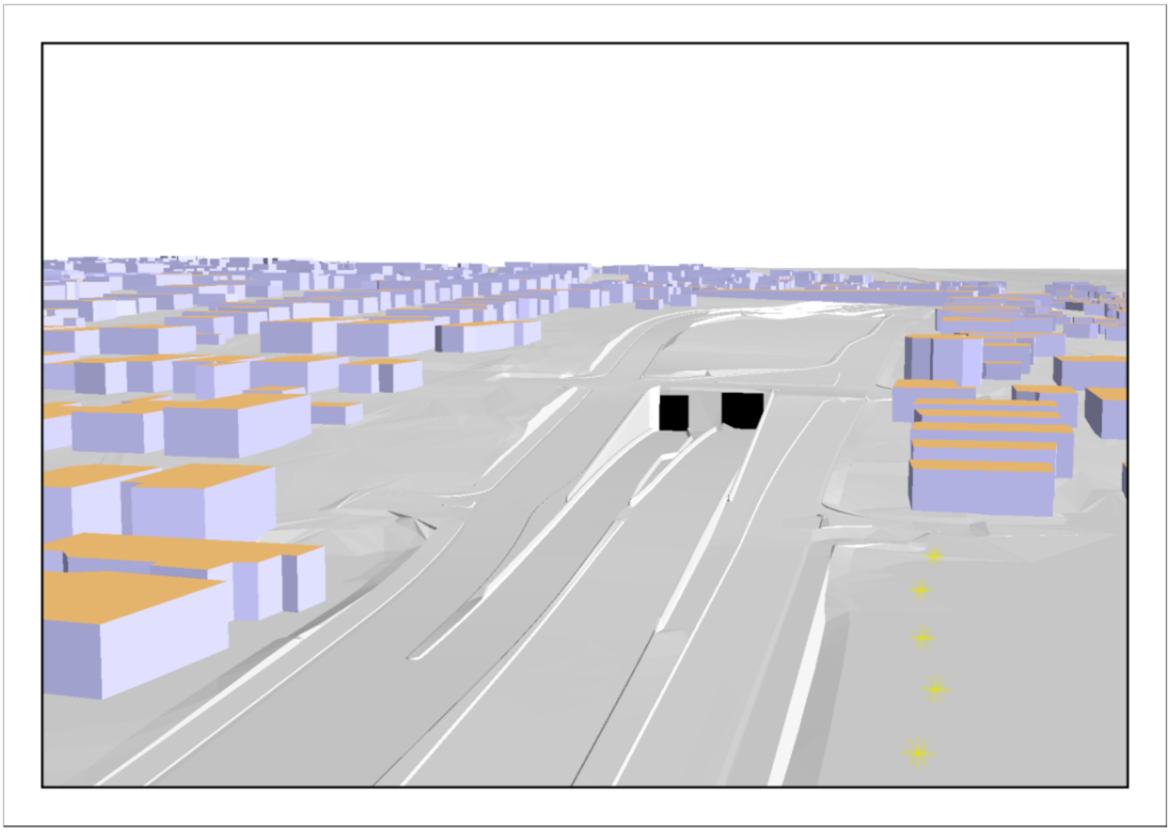

**Figure 2.2** **EIS Wattle Street interchange (oblique elevation, facing south)**

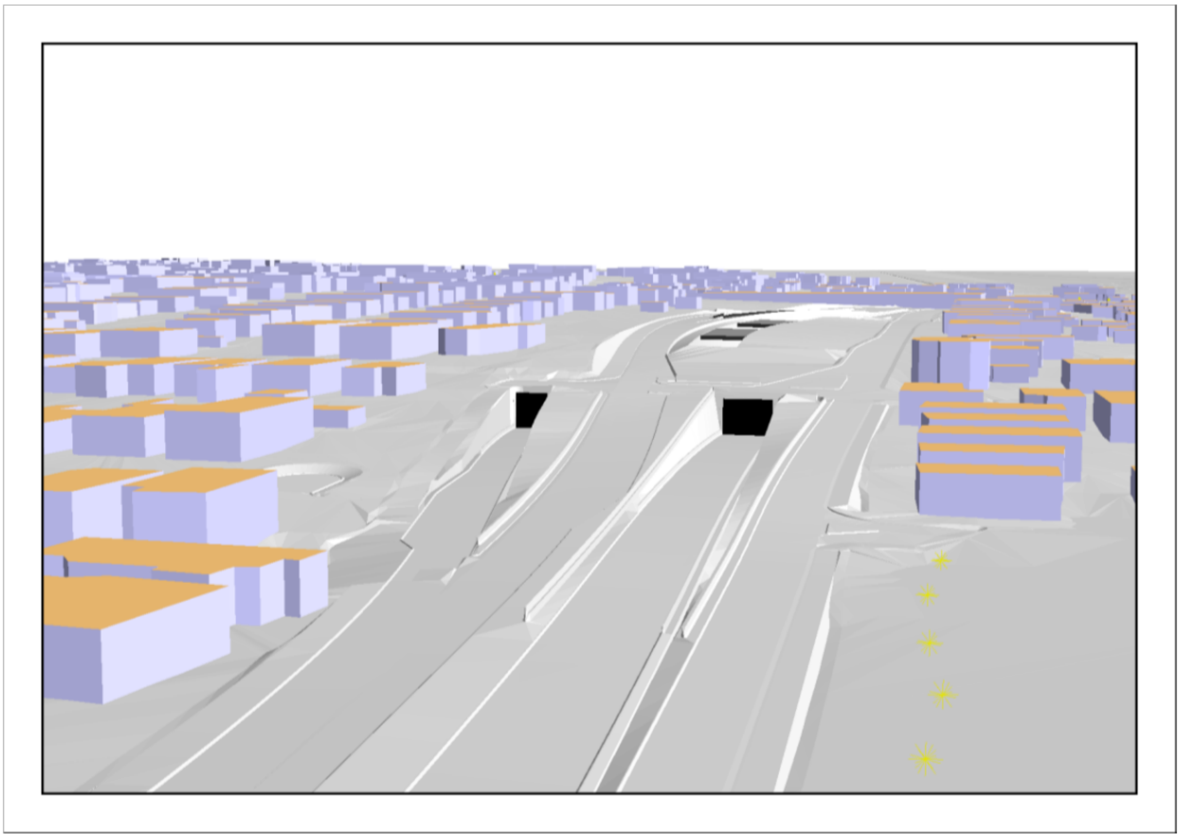

**Figure 2.3** **Reconfigured Wattle Street interchange (oblique elevation, facing south)**

## 2.2 Description of design change – Sydney Street substation re-orientation

The proposed Sydney Street substation at the Concord Road interchange is located within the Powell's Estate Heritage Conservation Area.

As described in the EIS, the substation was proposed to be orientated perpendicular to Sydney Street with a frontage to Concord Lane.

Following further design development and in response to issues raised by the community, it is proposed to re-orientate the substation so it runs parallel to Sydney Street. The substation would have frontage to Sydney Street, Concord Road and Concord Lane.

The proposed re-orientation will be similar to the orientation of the existing residences at 68, 70 and 72 Concord Road, which are proposed be demolished to make way for the cut and cover section of the Concord Road interchange and sub-station. The demolition of these properties was previously assessed in Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment. This assessment focusses on the re-orientation of the substation.

# 3 Existing environment

## 3.1 Wattle Street interchange

23 Martin Street is located on the northern side of the street adjacent to its intersection with Wattle Street. The western side of Wattle Street consists of freestanding, single storey, post war red brick (circa 1945-1960s) residences. Residences on the eastern side of the street predominantly consist of Federation architecture and an undistinguished bungalow, circa 1970s.

The following description of the Haberfield Heritage Conservation Area, which 23 Martin Street is located within, is from Section 6.7.3 of Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment.

Haberfield differs from the Victorian inner suburbs which preceded it because it comprises generous suburban allotments which contain one house only. It is characterised by a uniform pattern of development: roads are of a regular width with the original tree planting remaining on many of the verges; because a drainage and sewerage system was in place at the back of the lot before building began there is a lack of night-soil back lanes; lots are of similar width and allowed fresh air to flow between the buildings; and length of lots vary where the street pattern diverges in response to the alignment of earlier roads – Parramatta Road, Ramsay Street and other tracks on the Dobroyd Estate.

(Source: Ashfield Council, Interim Development Assessment Policy 2013 – Part C7 Haberfield Heritage Conservation Area)

## 3.2 Sydney Street sub-station re-orientation

The following description of the Powell's Estate Heritage Conservation Area is from Section 6.5.3 of the HIA.

Victorian period subdivision featuring a regular layout and uniform allotments. Houses from all periods from the 1880s to the 1940s are represented. Notable Victorian survivors include a few modest villas and smaller cottages. Despite some loss of integrity major elements persist.

### Setting

The Powell's Estate has regular sized allotments on a rectilinear street layout. Street trees provide amenity to the area. Lanes now allow vehicular access to the rear of the allotments.

### Scale

Single storey housing is dominant. A few one and a half and two storey houses are located on double allotments. A notable one and a half storey group faces Concord Road.

### Form

The houses in this conservation area include free standing and semidetached forms. Most have a simple rectilinear footprint to the main front wing and incorporate a verandah in the street elevation. Roofs are usually hipped, sometimes incorporating a gable as a feature.

### Siting

Front setbacks are reasonably uniform along each street. Some larger houses have greater setbacks. Side setbacks are small, possibly as a result of the small allotments.

### Materials and colours

Rendered masonry is used for most of the Victorian houses and is complemented by slate roofs (where the original roofing survives). Later houses are face brick with tiled roofs. There are a small number of weatherboard houses with corrugated steel roofs.

### Doors and windows

Windows are vertically proportioned usually with timber double hung sashes. Some of the Victorian houses incorporate bay window elements. A few later homes have sets of timber casement sashes. Front doors usually incorporate a toplight and, in larger homes, sidelights.

### Car parking

The rear lanes provide access for parking at the rear of the properties.

### Fencing

Few original fences survive. Iron palisades might be expected for some of the larger Victorian houses. Smaller cottages could be expected to have timber picket fences. Later houses appear to have used brick fencing with low brick panels between brick piers.

### Landscape elements including paving and driveways

Front gardens are dominated by lawns with plantings of low shrubs.

*(Source: NSW State Heritage Inventory)*

# 4 Assessment of impacts

## 4.1 Wattle Street re-design

### 4.1.1 Construction impacts

The proposed design change to the Wattle Street interchange will result in the acquisition and demolition of an additional freestanding residence at 23 Martin Street. This property is located on the northern side of Martin Street and to the east of its intersection with Wattle Street.


**Figure 4.1 Aerial of 23 Martin Street (Source: Google Maps 2015)**

The house at 23 Martin Street is a freestanding post war red brick (circa 1945-1960s) residence **(Figure 4.2)**. The hip roof is clad in terracotta tiles, with projecting hip to Martin Street. The main façade faces Martin Street. Windows are timber framed and double hung. An undercroft garage is accessed from Martin Street, as is a pedestrian pathway with a late aluminium handrail, which leads to a balcony and the front entrance, located above the garage.

**Figure 4.2 23 Martin Street as viewed from the street. (Source: Google Streetview 2015).**

The house at 23 Martin Street is a freestanding post war red brick (circa 1945-1960s) residence which does not contribute to the predominant Federation architectural style within the Haberfield HCA.

The property is not listed as a heritage item on the Ashfield Local Environmental Plan 2013 (LEP 2013) or on the RMS Section 170 Heritage and Conservation Register. It is located within the Haberfield Heritage Conservation Area (HCA) and has been identified as a neutral item in Appendix S of the EIS – Non Aboriginal Heritage Impact Assessment. It has not been identified as a potential heritage item.

The land is part of the development on the northern side of Park Street (now Martin Street) purchased by William Lambert in 1915. The original subdivision design is evident in the existing street layout and the pattern of the freestanding and semi-detached houses including 23 Martin Street. Its freestanding character is complementary to that of the streetscapes in the Haberfield HCA. The residence is not evident in the 1943 aerial photo.

23 Martin Street is not considered to be a potential heritage item as it does not have any aesthetic or social significance. The original subdivision design is evident in the existing street layout and the pattern of the freestanding and semi-detached houses. Its freestanding character is complementary to that of the streetscapes in the Haberfield HCA.

The following heritage impact assessment assesses the heritage impact of the proposed design change for the Wattle Street interchange in respect of 23 Martin Street and any impact this may have on the heritage significance of the Haberfield HCA.

The proposed design change to the Wattle Street interchange will result in the acquisition and demolition of the freestanding residence at 23 Martin Street.

The proposed works associated with the project in the vicinity of 23 Martin Street include:

- a dive structure and cut-and-cover tunnel and
- the Wattle Street and Walker Avenue civil site (C9).

The tangible heritage values of Haberfield HCA are embodied in its highly intact streets of detached and semi-detached dwellings of consistent setback, scale and materials, set within landscaped gardens, as well as its subdivision pattern and landscape character. Haberfield HCA is Australia's first comprehensively planned and marketed garden suburb, with the original subdivision layout designed by Richard Stanton.

Of the 53 properties proposed to be demolished within the Haberfield HCA, 29 have been identified as contributory, 6 as neutral (including 23 Martin Street) and 7 as intrusive in the HIA. The remaining 11 are individually listed as heritage items. Most of the contributory items and heritage items proposed to be demolished are intact examples of Australian Federation style bungalows and duplexes and have landscaped gardens. All of these elements contribute to the heritage values of the Haberfield HCA.

The residence at 23 Martin Street is freestanding post war red brick (circa 1945-1960s) residence and does not contribute to the predominant Federation architectural style within the Haberfield HCA. The original subdivision design is evident in the existing street layout and the pattern of the freestanding and semi-detached houses. Its freestanding character is complementary to that of the streetscapes in the Haberfield HCA.

Notwithstanding that it is rated neutral, demolition of 23 Martin Street will impact on the historic significance of the Haberfield HCA as it will result in the further diminution of the original subdivision layout. This will adversely affect the heritage significance of the Haberfield HCA with the interruption to the regular built rhythm and building setbacks within the Martin Street streetscape. The demolition will also result in visual impacts within the Haberfield Precinct associated with changes to built form and landscaping. The proposed demolition of 23 Martin Street will contribute to high visual impacts within the Haberfield HCA.

The Wattle Street interchange re-design and the demolition of 23 Martin Street may also add to an impact on the social significance of the Haberfield HCA, particularly for the residents who live west of Wattle Street who would be visually and spatially separated from the remainder of the suburb by the project.

The general and specific mitigation measures for heritage as amended in Chapter 8 of the submission report (revised environmental management measures) apply to the management of heritage for the demolition of 23 Martin Street.

### 4.1.2 Operational impacts

There will be no operational impacts from a heritage perspective, as a result of the proposed demolition of 23 Martin Street.

### 4.1.3 Cumulative impacts

The proposed Wattle Street interchange design change and subsequent demolition of 23 Martin Street will exacerbate the cumulative adverse impact on the heritage significance of the Haberfield HCA.

## 4.2 Sydney Street substation re-orientation

### 4.2.1 Construction impacts

Assessment of construction impacts as a result of the proposed design change.

The proposed re-orientation of the substation means it will respond to the orthogonal orientation of the existing residences at 68, 70 and 72 Concord Road. The demolition of these properties was previously assessed in Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment. This assessment focusses on the re-orientation of the substation.

The impact on the heritage significance of the Powell's Estate HCA in Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment identified that the proposed distribution substation would further impact on the character and setting of the heritage conservation area.


**Figure 4.4** **From left to right 68, 70 and 72 Concord Road, Strathfield, viewed from diagonally opposite at the intersection with Sydney Street. (Source: GML).**

The re-orientation of the substation will be an improvement on the previously proposed orientation in the public exhibition version of the EIS because it will:

- be consistent with the orthogonal orientation of the existing residences along Concord Road including the existing residences proposed to be demolished to make way for the substation
- create the opportunity for future infill development on the site to address and complement the built form and streetscape character of Concord Road and the opportunity for future landscaping opportunities.

Recommended environmental management measures are listed in Chapter 8. The following heritage related measures are relevant to the substation:

- Where feasible the size and form of the proposed substation located near the corner of Sydney street and Concord Road will be designed to be as recessive as possible and incorporate sensitive landscape treatment to reduce permanent visual impacts on the remaining portion of the Powells Estate HCA
- Undertake photographic recording of listed and contributory heritage items and affected areas where a major adverse impact will be caused by the project as identified in the Construction Heritage Management Plan including within the Powells Estate HCA.

### 4.2.2 Operational impacts

There will be no operational impacts from a heritage perspective, as a result of the proposed re-orientation of the substation.

### 4.2.3 Cumulative impacts

No cumulative impacts from a heritage perspective will result from the re-orientation of the substation.

# 5 Additional management measures

No additional mitigation measures are recommended in respect of the potential heritage impacts associated with the proposed design changes at the Wattle Street interchange and the re-orientation of the Sydney Street substation.

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# 6 Conclusion

The proposed design change at the Wattle Street interchange will result in the demolition of the house at 23 Martin Street. This house is a freestanding post war red brick (circa 1945-1960s) residence which does not contribute to the predominant Federation architectural style within the Haberfield HCA.

The property is not listed as a heritage item on the Ashfield Local Environmental Plan 2013 (LEP 2013) or on the RMS Section 170 Heritage and Conservation Register. It is located within the Haberfield Heritage Conservation Area (HCA) and has been identified as a neutral item in Appendix S of the EIS – Non-Aboriginal Heritage Impact Assessment. It has not been identified as a potential heritage item.

Notwithstanding that it is rated neutral, demolition of 23 Martin Street will impact on the historic significance of the Haberfield HCA as it will result in the further diminution of the original subdivision layout. This will adversely affect the heritage significance of the Haberfield HCA with the interruption to the regular built rhythm and building setbacks within the Martin Street streetscape. The demolition will also result in visual impacts within the Haberfield Precinct associated with changes to built form and landscaping.

The re-orientation of the Sydney Street substation will be an improvement on the previously proposed orientation as it will better relate to the character of the Powell's Estate HCA, the subdivision design and the building layout within the Concord Road streetscape. It will be consistent with the orientation of the existing residences and subdivision pattern along Concord Road and will create an opportunity for future infill development on the site to address and complement the built form and streetscape character of Concord Road.

The revised environmental management measures relevant to heritage detailed in Chapter 8 of the submissions report are appropriate to manage impacts associated with the proposed design changes. No additional management measures are required.

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