

APPENDIX A: MEAN PATH LOSSES AND BUILDING LAYOUTS FOR RESIDENCES

Figures A-1 through A-14 show residential layouts, with median path losses (dB) by room and standard deviations (dB) in parentheses. In the figures, measured losses are displayed by room in order of increasing frequency, i.e., 912 MHz (top number in each room), 1920 MHz (middle number), and 5990 MHz (bottom number). Reference path loss and standard deviation are indicated on the outside of the building. The direction of the arrow by the reference measurements indicates the direction in which the receiver was moving while the measurements were taken. In cases where the transmitter was facing a corner of the building, reference measurements were taken on both walls that made up that corner. Approximate building dimensions are indicated within the double-headed arrows. The direction in which the transmitter was located is indicated by the large arrow.

Table A-1 shows the mean building path losses and standard deviations for each residence. Table A-2 shows the mean path loss for all residences combined. Table A-3 shows the path losses for the basements, first floors, and second floors of the residences separately. All path losses and standard deviations are given in decibels.

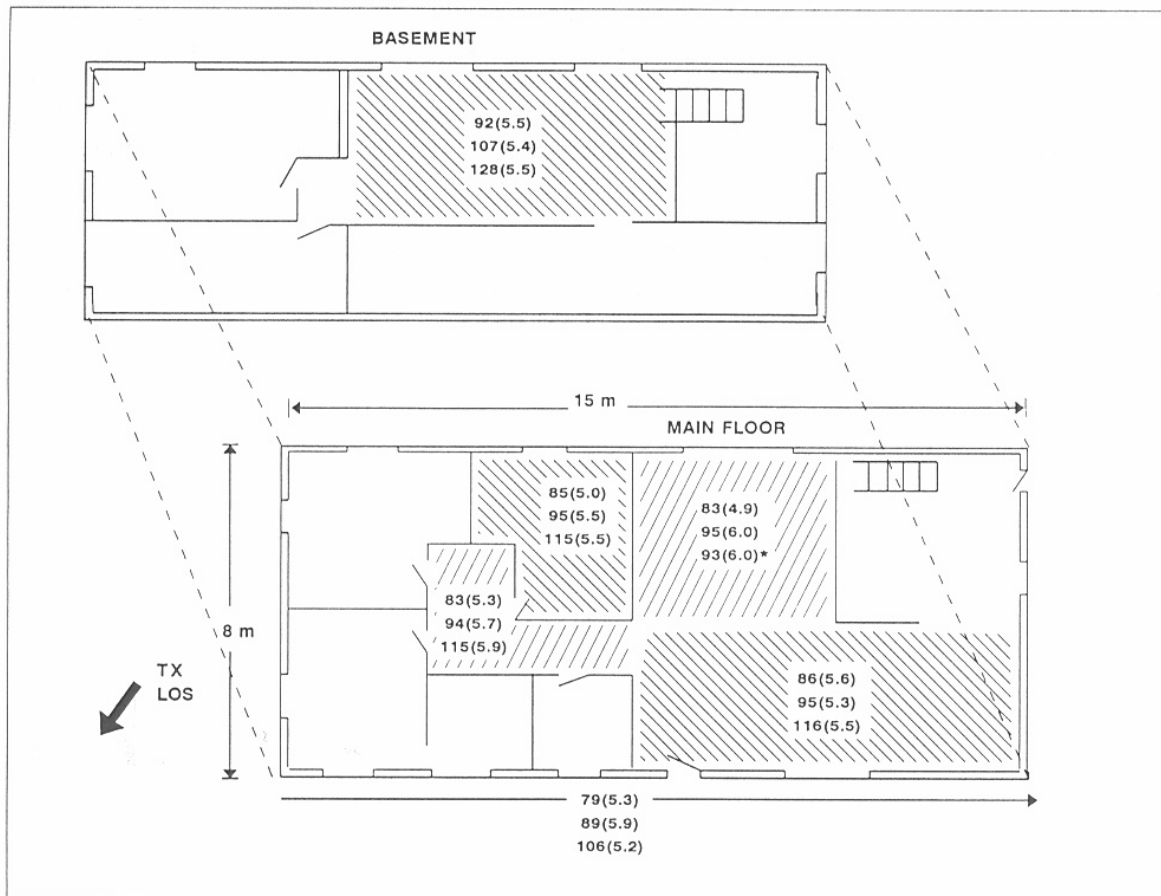


Figure A-1. Residence-1 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses. (*5990-MHz data in this room were not used for analysis)

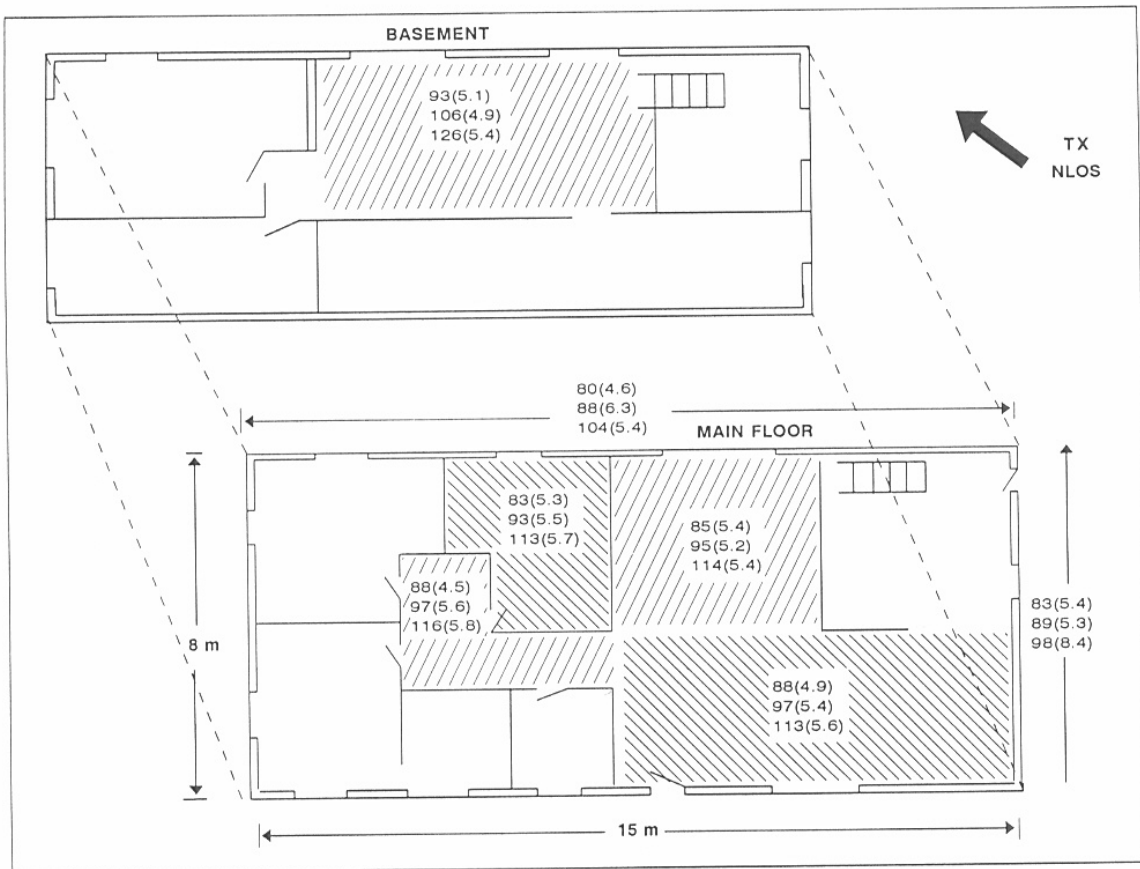


Figure A-2. Residence-1 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

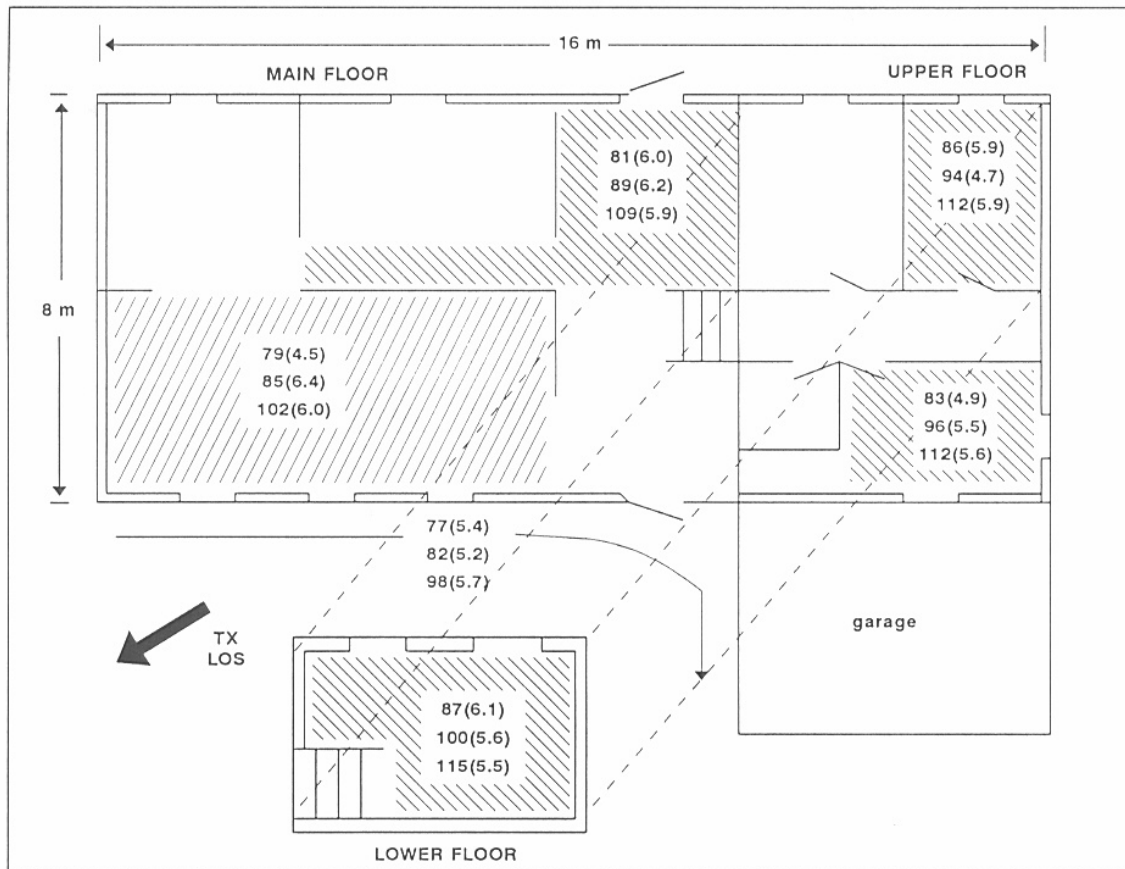


Figure A-3. Residence-2 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses.

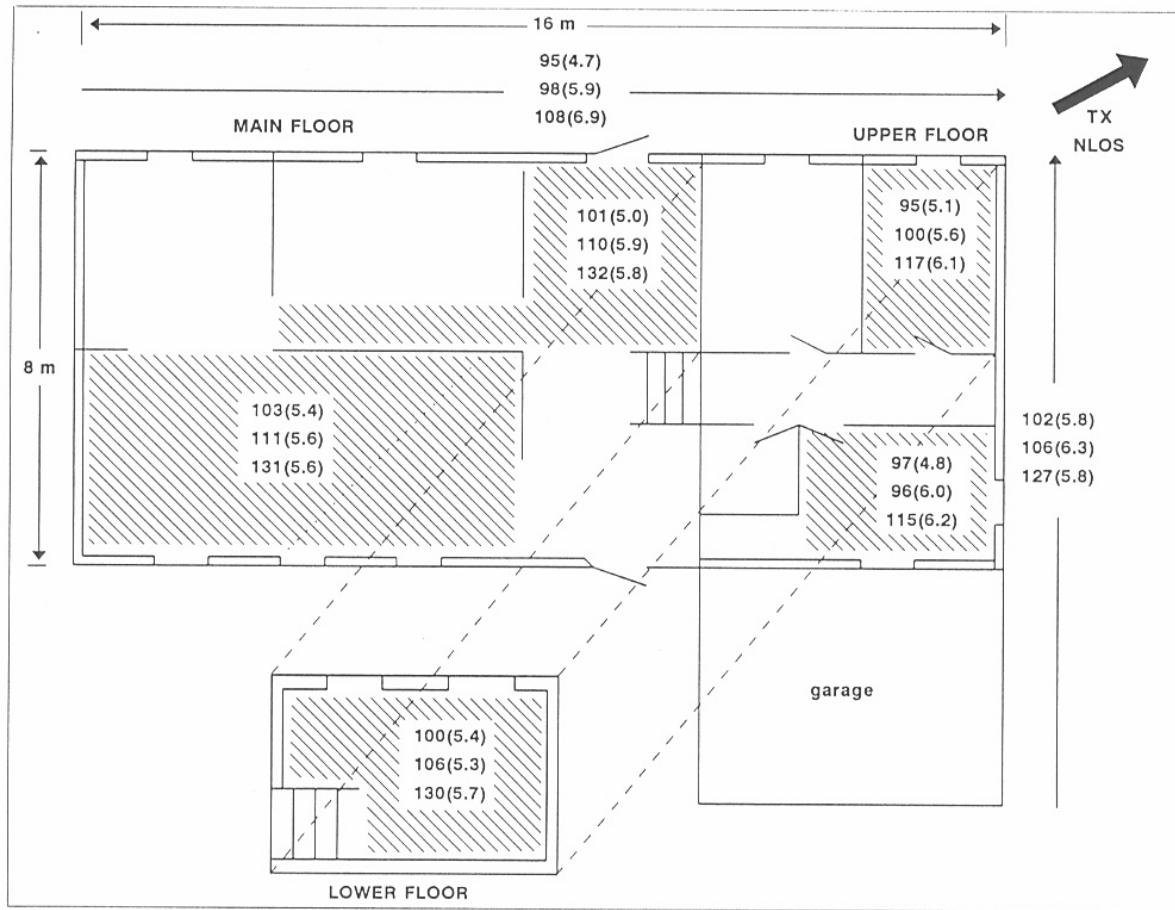


Figure A-4. Residence-2 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

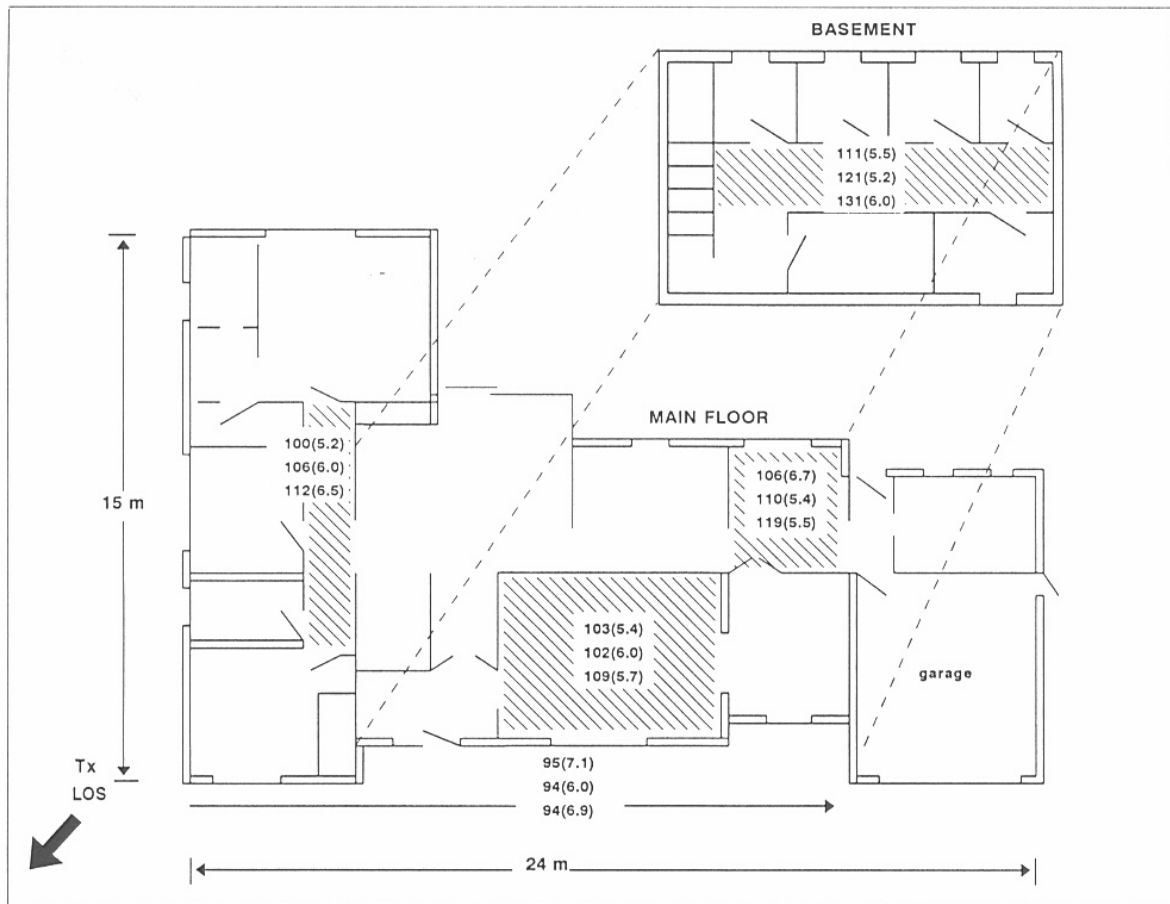


Figure A-5. Residence-3 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses.

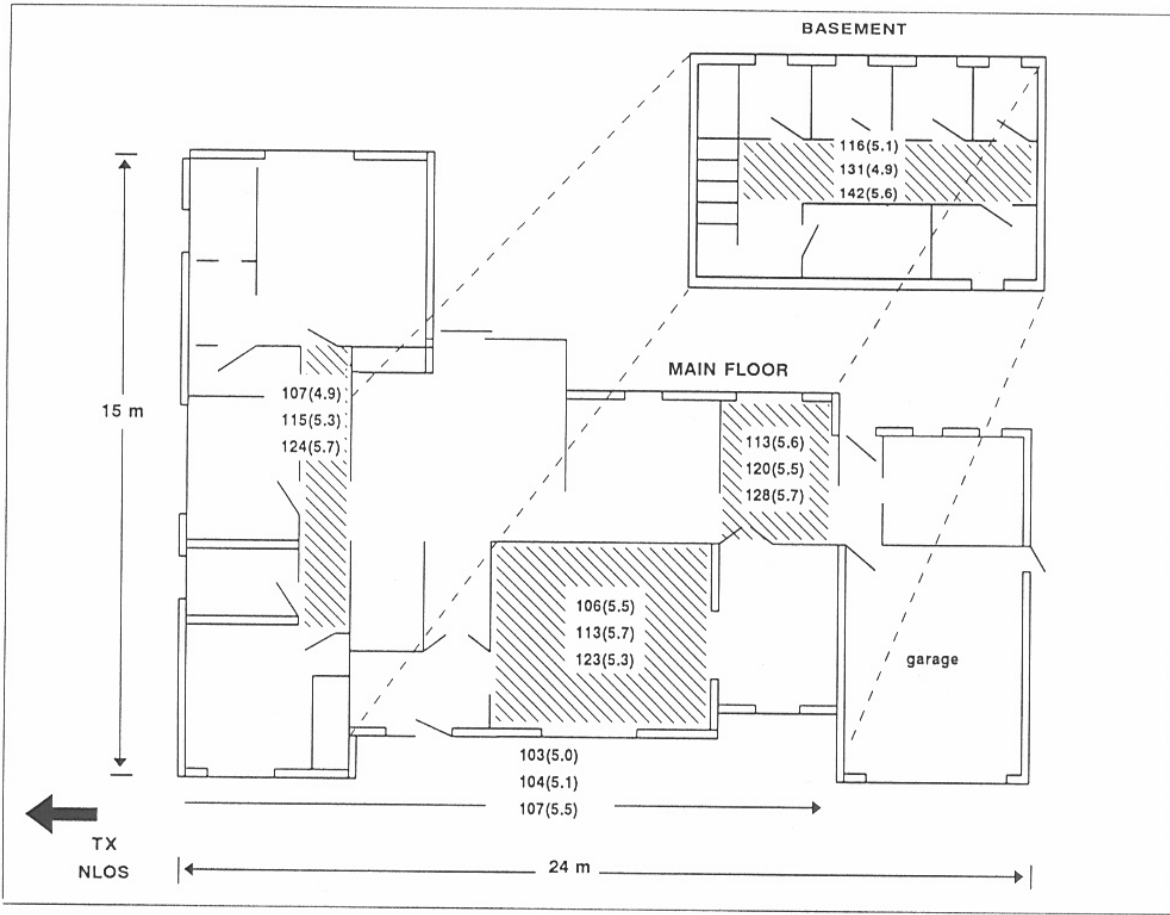


Figure A-6. Residence-3 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

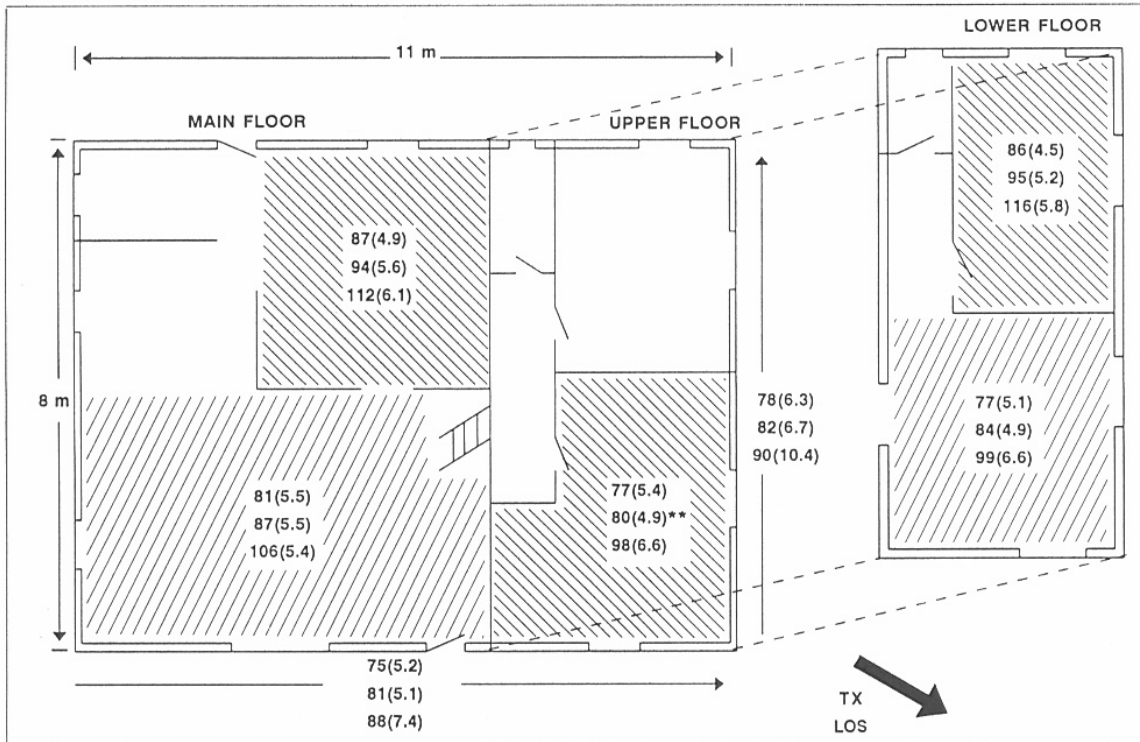


Figure A-7. Residence-4 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses. (**1920-MHz data in this room were not used for analysis)

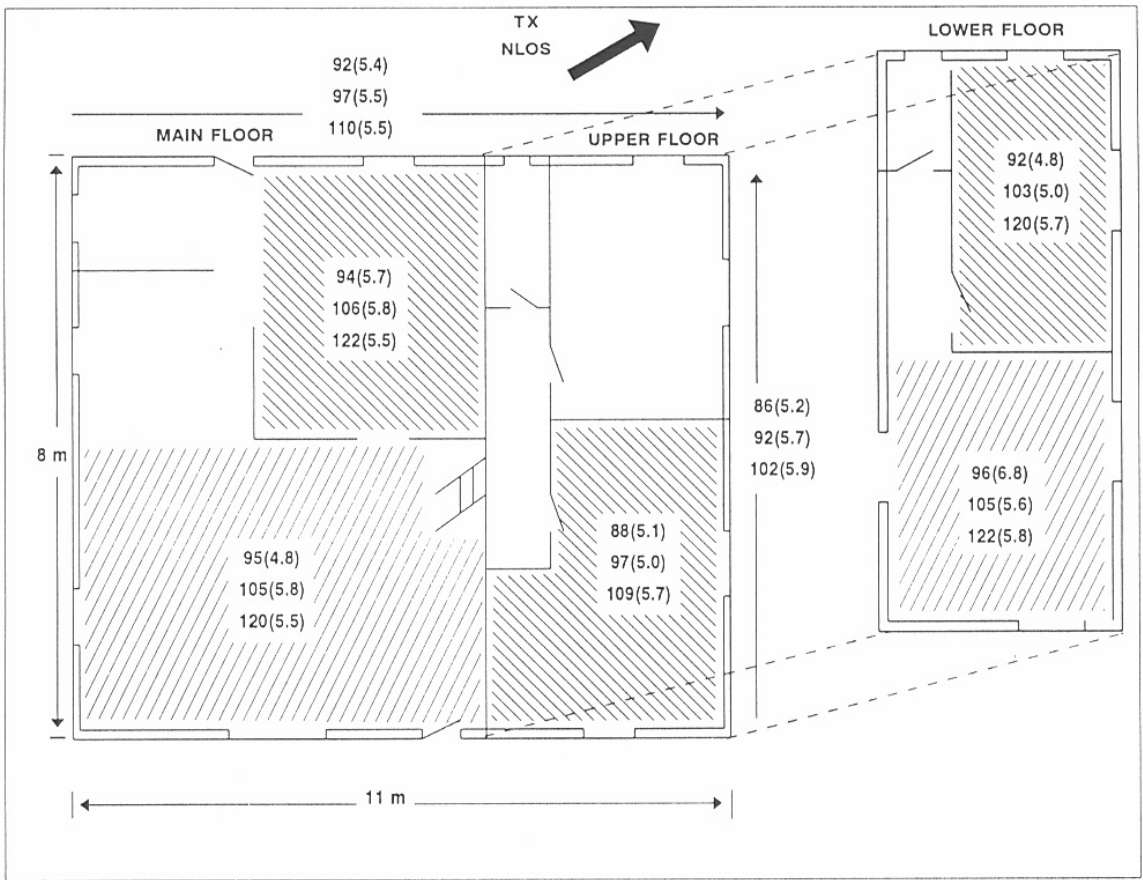


Figure A-8. Residence-4 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

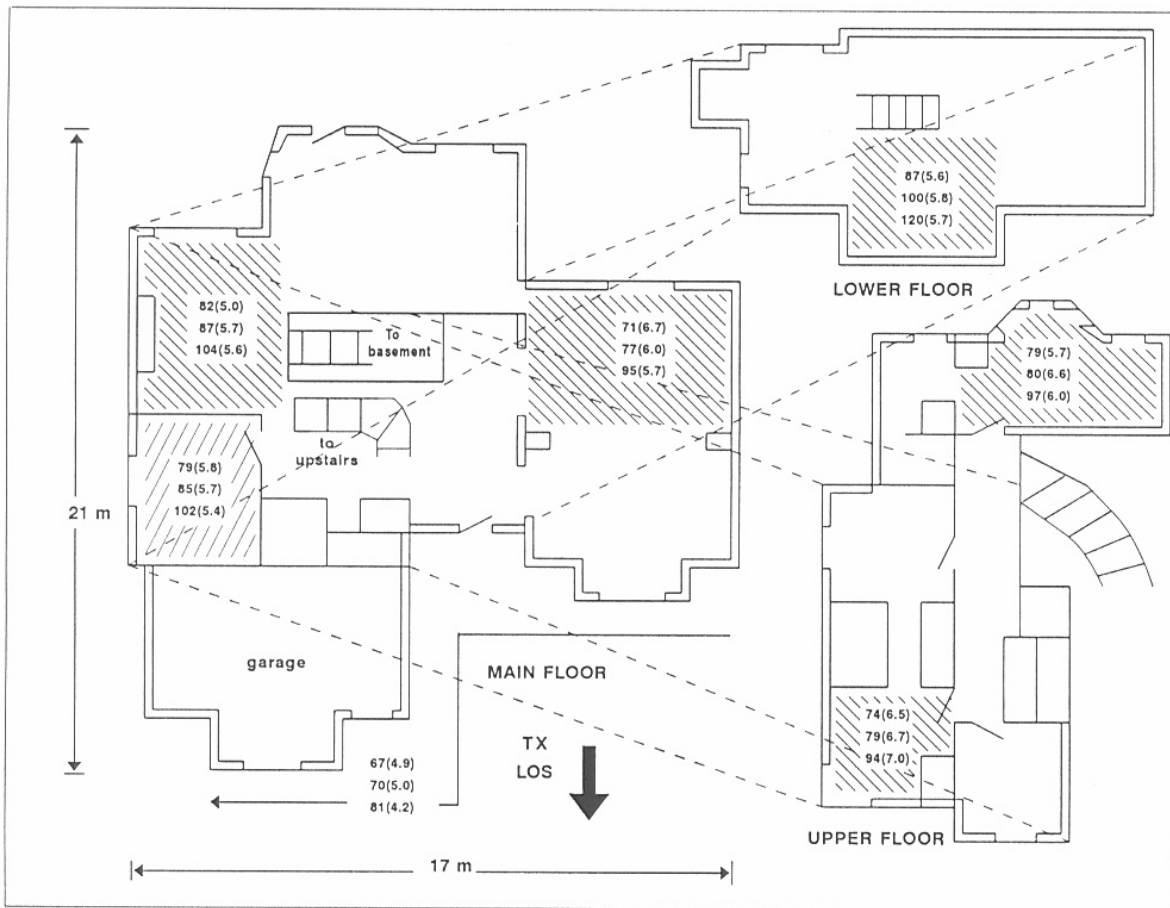


Figure A-9. Residence-5 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses.

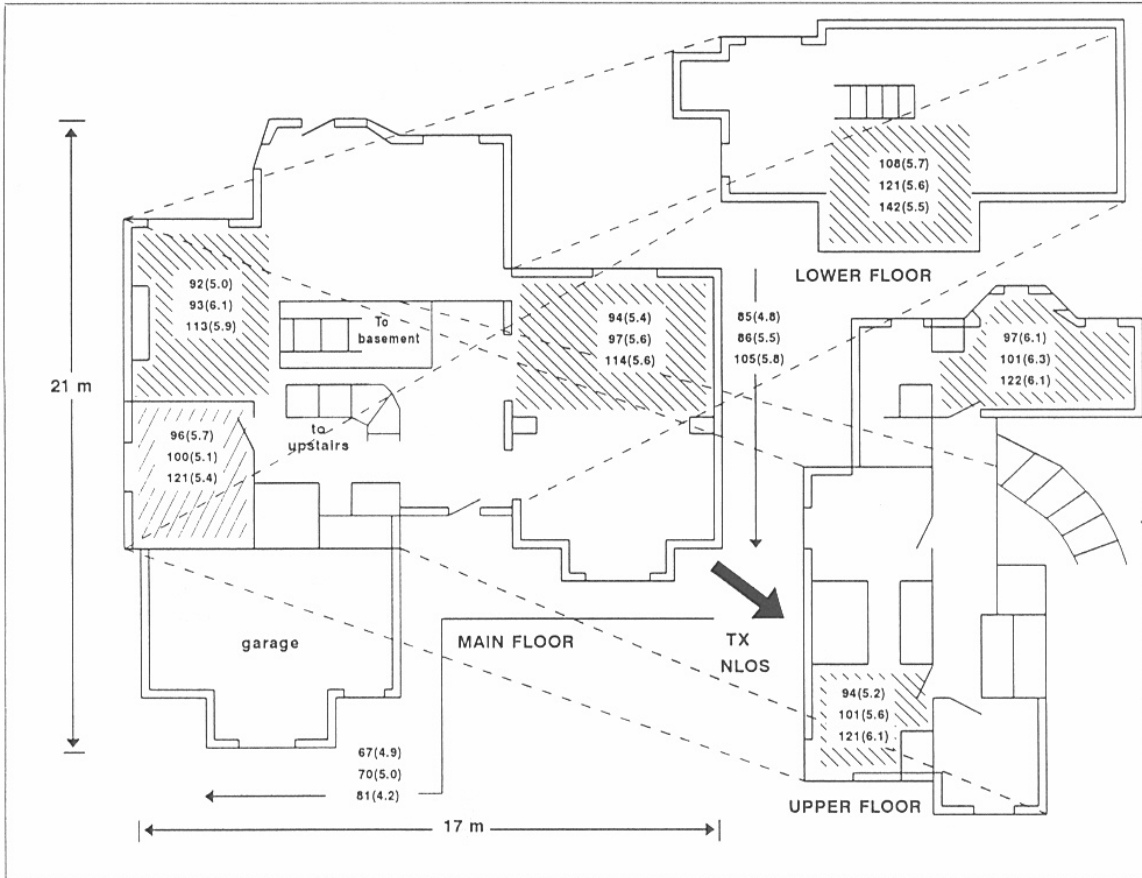


Figure A-10. Residence-5 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

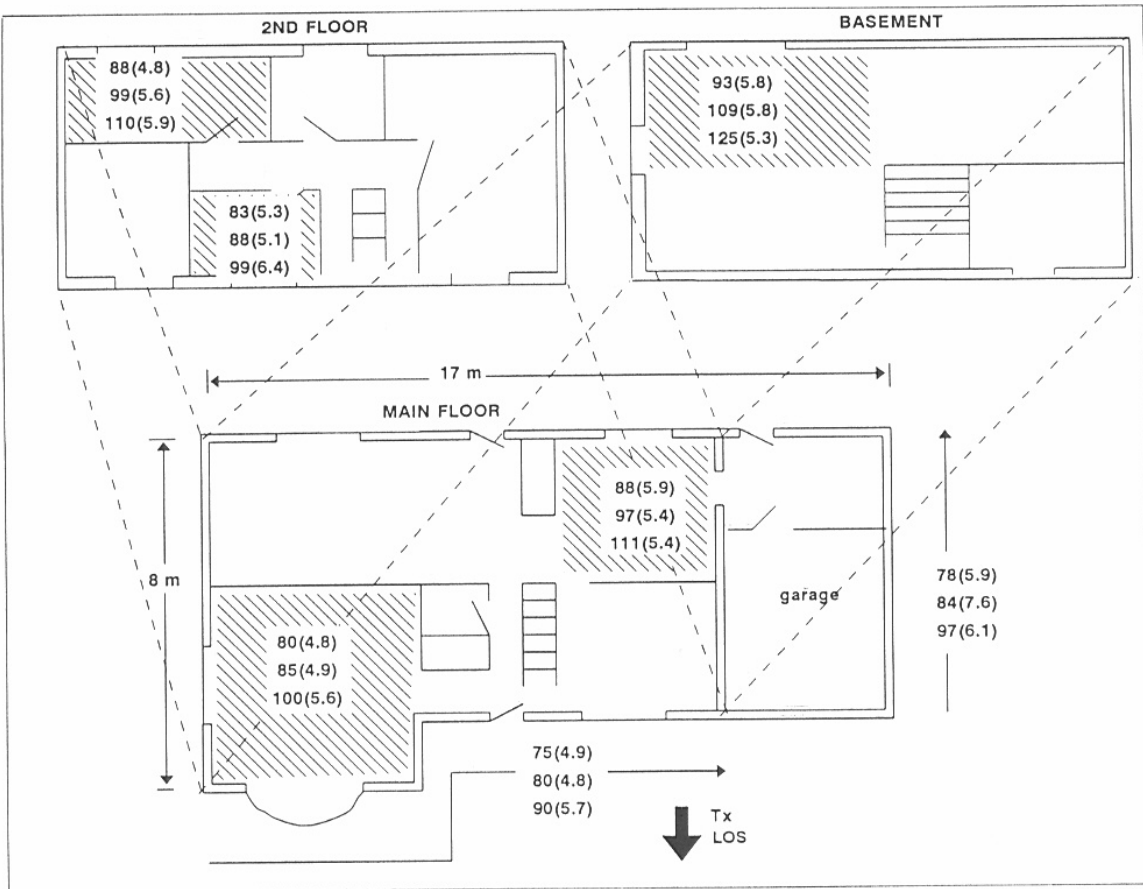


Figure A-11. Residence-6 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses.

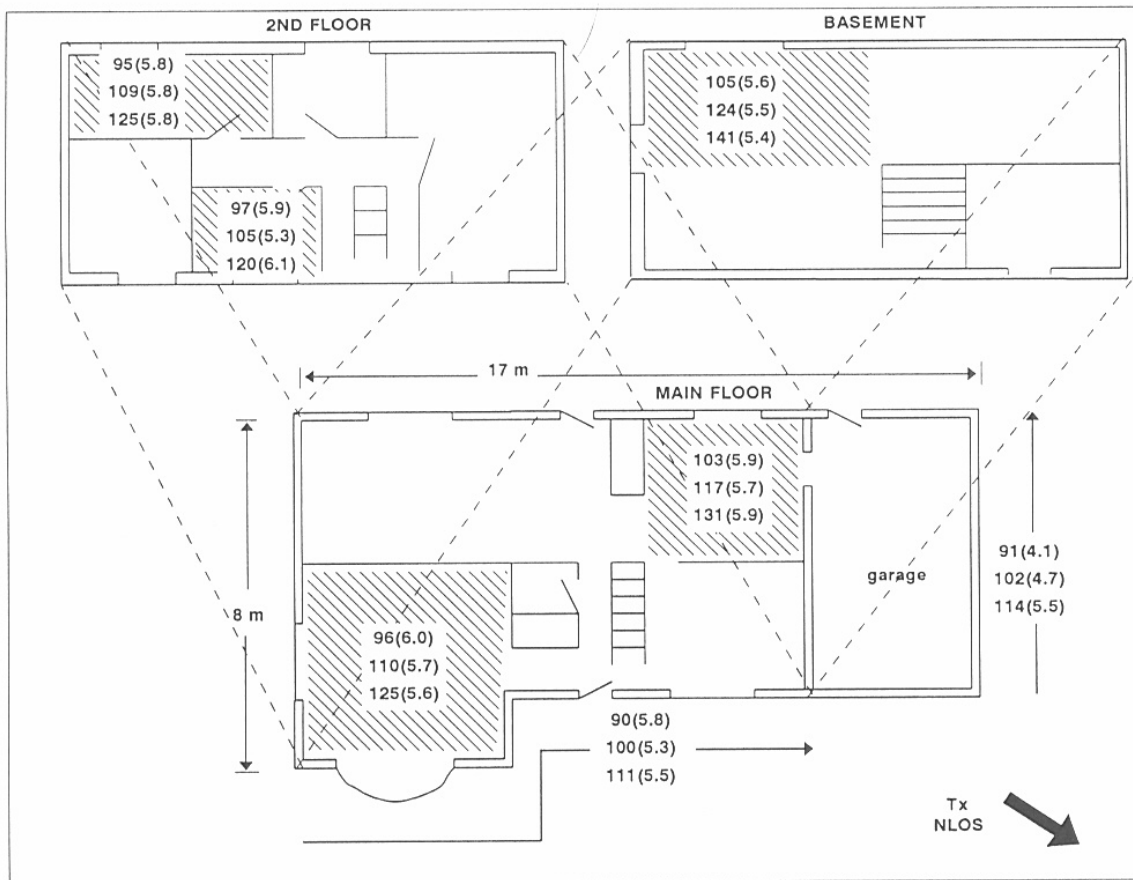


Figure A-12. Residence-6 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

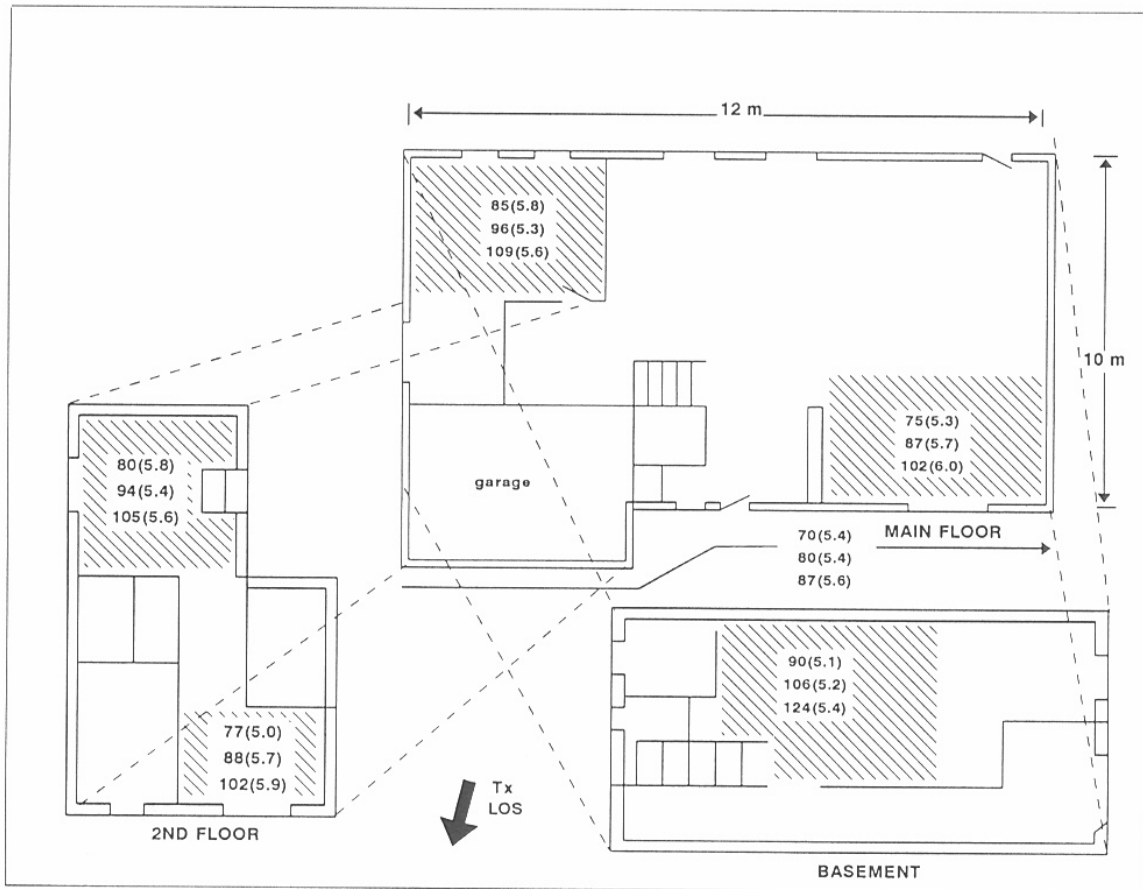


Figure A-13. Residence-7 layout: median LOS path losses (dB) per room; standard deviations are indicated in parentheses.

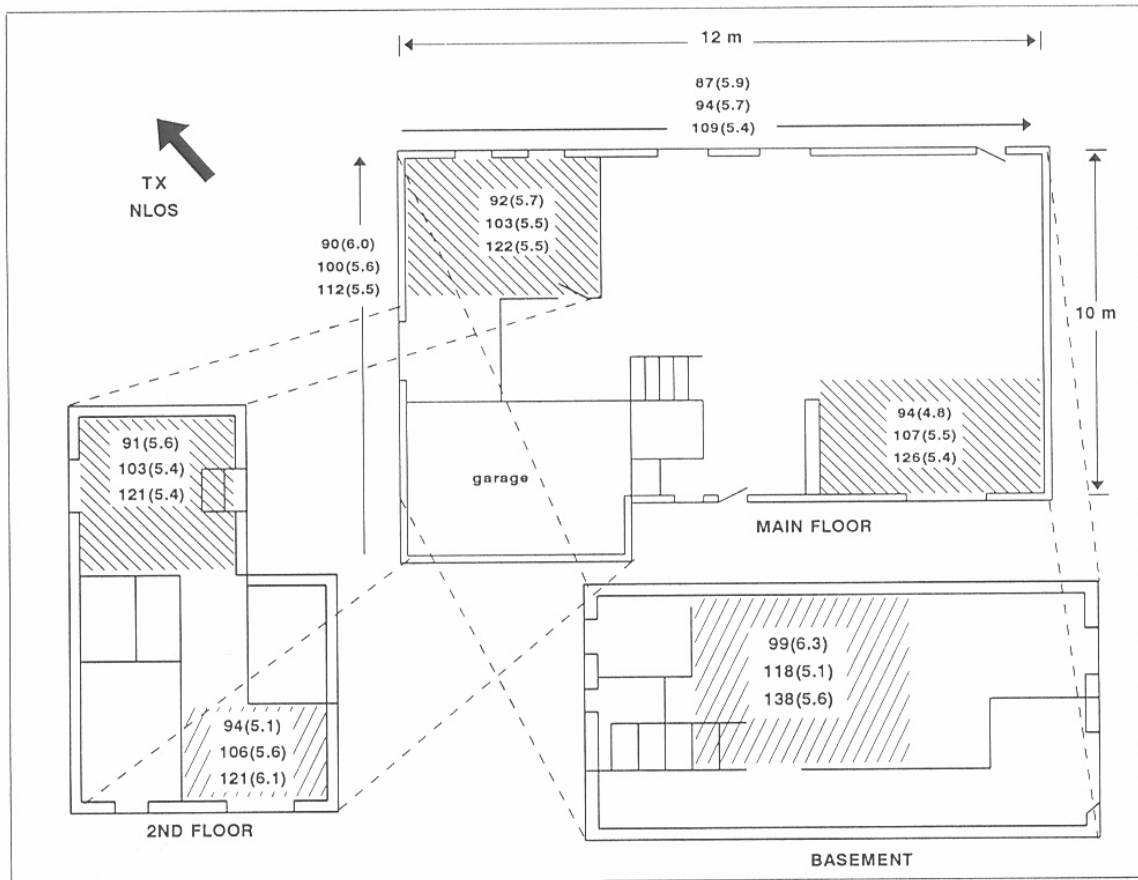


Figure A-14. Residence-7 layout: median NLOS path losses (dB) per room; standard deviations are indicated in parentheses.

Table A-1. Mean Path Losses for Each Residence

| Residence | Path | Frequency (MHz) | Mean Path Loss (dB) | σ (dB) |
|-----------|-------|-----------------|---------------------|---------------|
| 1 | LOS | 912 | 85.0 | 6.3 |
| | NLOS | | 86.4 | 6.1 |
| | Both* | | 85.7 | 6.2 |
| | LOS | 1920 | 95.8 | 7.4 |
| | NLOS | | 96.1 | 6.9 |
| | Both | | 95.9 | 7.2 |
| | LOS | 5990 | 100.2 | 7.7 |
| | NLOS | | 114.6 | 7.4 |
| | Both | | 103.2 | 7.6 |
| 2 | LOS | 912 | 82.0 | 6.6 |
| | NLOS | | 98.4 | 6.0 |
| | Both | | 85.0 | 10.2 |
| | LOS | 1920 | 90.0 | 7.5 |
| | NLOS | | 101.4 | 8.1 |
| | Both | | 92.7 | 9.9 |
| | LOS | 5990 | 107.6 | 7.2 |
| | NLOS | | 120.0 | 9.0 |
| | Both | | 110.5 | 11.2 |
| 3 | LOS | 912 | 103.5 | 7.1 |
| | NLOS | | 108.7 | 6.6 |
| | Both | | 105.4 | 7.3 |
| | LOS | 1920 | 106.1 | 8.9 |
| | NLOS | | 116.5 | 8.6 |
| | Both | | 108.7 | 10.0 |
| | LOS | 5990 | 112.9 | 10.3 |
| | NLOS | | 125.7 | 9.4 |
| | Both | | 115.7 | 11.3 |

* Both refers to the mean value of the LOS and NLOS paths.

Table A-1. Mean Path Losses for Each Residence (cont.)

| Residence | Path | Frequency (MHz) | Mean Path Loss (dB) | σ (dB) |
|-----------|------|-----------------|---------------------|---------------|
| 4 | LOS | 912 | 79.7 | 6.6 |
| | NLOS | | 92.2 | 6.3 |
| | Both | | 82.5 | 8.7 |
| | LOS | 1920 | 87.5 | 8.0 |
| | NLOS | | 102.0 | 6.4 |
| | Both | | 90.4 | 10.6 |
| | LOS | 5990 | 102.2 | 9.1 |
| | NLOS | | 114.7 | 7.5 |
| | Both | | 105.0 | 10.2 |
| 5 | LOS | 912 | 76.1 | 7.4 |
| | NLOS | | 95.3 | 7.6 |
| | Both | | 79.1 | 11.6 |
| | LOS | 1920 | 80.8 | 9.8 |
| | NLOS | | 98.1 | 10.5 |
| | Both | | 83.7 | 13.4 |
| | LOS | 5990 | 97.6 | 10.4 |
| | NLOS | | 117.3 | 11.0 |
| | Both | | 100.6 | 14.6 |
| 6 | LOS | 912 | 84.4 | 7.2 |
| | NLOS | | 97.4 | 7.3 |
| | Both | | 87.2 | 9.7 |
| | LOS | 1920 | 90.2 | 10.3 |
| | NLOS | | 109.4 | 8.7 |
| | Both | | 93.2 | 12.9 |
| | LOS | 5990 | 103.3 | 10.8 |
| | NLOS | | 124.3 | 9.3 |
| | Both | | 106.3 | 13.9 |

Table A-1. Mean Path Losses for Each Residence (cont.)

| Residence | Path | Frequency (MHz) | Mean Path Loss (dB) | σ (dB) |
|-----------|------|-----------------|---------------------|---------------|
| 7 | LOS | 912 | 79.0 | 7.6 |
| | NLOS | | 93.3 | 6.3 |
| | Both | | 81.8 | 9.4 |
| | LOS | 1920 | 90.5 | 8.7 |
| | NLOS | | 105.4 | 7.5 |
| | Both | | 93.4 | 10.5 |
| | LOS | 5990 | 104.5 | 9.9 |
| | NLOS | | 123.0 | 8.5 |
| | Both | | 107.5 | 12.6 |

Table A-2. Mean Path Losses for All Residences (Calculated From Table A-1)

| Path | Frequency (MHz) | Mean Path Loss (dB) |
|------|-----------------|---------------------|
| LOS | 912 | 80.6 |
| NLOS | | 92.4 |
| Both | | 83.4 |
| LOS | 1920 | 87.2 |
| NLOS | | 100.8 |
| Both | | 90.0 |
| LOS | 5990 | 102.1 |
| NLOS | | 118.1 |
| Both | | 105.0 |

Table A-3. Mean LOS Floor Path Loss for Residences

| Residence | Frequency (MHz) | Mean Path Loss (dB) | | |
|-----------|-----------------|---------------------|--------------|----------|
| | | Main Floor | Second Floor | Basement |
| 1 | 912 | 84.4 | N/A* | 91.6 |
| | 1920 | 94.7 | | 106.6 |
| | 5990 | 115.3 | | 127.5 |
| 2 | 912 | 80.9 | 84.3 | N/A |
| | 1920 | 88.3 | 95.0 | |
| | 5990 | 106.1 | 112.0 | |
| 3 | 912 | 102.4 | N/A | 110.6 |
| | 1920 | 104.8 | | 121.2 |
| | 5990 | 111.6 | | 131.0 |
| 4 | 912 | 80.7 | N/A | N/A |
| | 1920 | 87.5 | | |
| | 5990 | 104.3 | | |
| 5 | 912 | 75.0 | 76.1 | 86.8 |
| | 1620 | 80.6 | 79.2 | 100.3 |
| | 5990 | 98.6 | 95.0 | 119.9 |
| 6 | 912 | 82.6 | 84.9 | 93.5 |
| | 1920 | 88.1 | 90.8 | 109.4 |
| | 5990 | 102.9 | 101.8 | 125.4 |
| 7 | 912 | 77.7 | 78.5 | 89.5 |
| | 1920 | 89.1 | 90.1 | 106.1 |
| | 5990 | 103.8 | 103.3 | 124.1 |

* N/A means that the measurement does not apply to this building.

APPENDIX B: MEAN PATH LOSSES FOR HIGH-RISE BUILDINGS

Tables B-1 through B-4 show the path losses measured on each floor of the high-rise buildings. It was not possible to measure on all floors of the high-rise buildings, nor was it possible to collect data for each transmission path on each floor. These situations are denoted in the tables by blank spaces. For each frequency, the first number is the LOS path loss, the second number is the NLOS path loss. Table B-5 shows the mean path losses and standard deviations for each high-rise building at each frequency measured. Table B-6 shows the mean path losses for all high-rise buildings at each frequency measured.

Table B-1. Mean Path Losses by Floor for High Rise 1

| Floor | 912 MHz | | 1920 MHz | | 5990 MHz | |
|----------|---------|------|----------|------|----------|------|
| | LOS | NLOS | LOS | NLOS | LOS | NLOS |
| 12 | 93* | | 98 | | 116 | |
| 11 | | | | | | |
| 10 | | | | | | |
| 9 | 93 | 108 | 99 | 119 | 115 | 135 |
| 8 | | | | | | |
| 7 | 93 | 109 | 98 | 116 | 114 | 136 |
| 6 | | | | | | |
| 5 | 91 | 109 | 95 | 114 | 113 | 136 |
| 4 | 91 | 110 | 96 | 116 | 112 | 137 |
| 3 | 91 | 110 | 95 | 116 | 114 | 137 |
| 2 | | 113 | | 120 | | 135 |
| 1 | 97 | 114 | 100 | 125 | 113 | 138 |
| Ground | 89 | 114 | 96 | 121 | 106 | 137 |
| Basement | | 135 | | 147 | | 153 |

* All data are given in decibels.

Table B-2. Mean Path Losses by Floor for High Rise 2

| Floor | 912 MHz | | 1920 MHz | | 5990 MHz | |
|--------------|---------|------|----------|------|----------|------|
| | LOS | NLOS | LOS | NLOS | LOS | NLOS |
| 11 | 82 | 115 | 97 | 125 | 114 | 140 |
| 10 | | | | | | |
| 9 | 93 | 121 | 105 | 134 | 119 | 145 |
| 8 | | | | | | |
| 7 | 81 | 115 | 92 | 130 | 106 | 146 |
| 6 | | | | | | |
| 5 | 83 | | 92 | | 109 | |
| 4 | 77 | 117 | 88 | 134 | 103 | 148 |
| 3 | 75 | 110 | 85 | 124 | 100 | 141 |
| 2 | 83 | 116 | 101 | 132 | 112 | 152 |
| 1 | 79 | 121 | 92 | 138 | 107 | 149 |
| Basement | 99 | | 124 | | 142 | |
| Sub-Basement | 132 | | 146 | | 154 | |

Table B-3. Mean Path Losses by Floor for High Rise 3

| Floor | 912 MHz | | 1920 MHz | | 5990 MHz | |
|----------|---------|------|----------|------|----------|------|
| | LOS | NLOS | LOS | NLOS | LOS | NLOS |
| 11 | 92 | 107 | 108 | 121 | 129 | 141 |
| 10 | | | | | | |
| 9 | 90 | 110 | 104 | 125 | 122 | 146 |
| 8 | | | | | | |
| 7 | 81 | 103 | 89 | 115 | 108 | 130 |
| 6 | | | | | | |
| 5 | 94 | 116 | 110 | 132 | 124 | 150 |
| 4 | 92 | 117 | 108 | 133 | 125 | 150 |
| 3 | 94 | 115 | 110 | 132 | 128 | 149 |
| 2 | 94 | 117 | 112 | 132 | 128 | 148 |
| 1 | 77 | 104 | 87 | 112 | 104 | 133 |
| Basement | 106 | 129 | 117 | 135 | 139 | 153 |

Table B-4. Mean Path Losses by Floor for High Rise 4

| Floor | 912 MHz | | 1920 MHz | | 5990 MHz | |
|----------|---------|------|----------|------|----------|------|
| | LOS | NLOS | LOS | NLOS | LOS | NLOS |
| 15 | 98 | 99 | 106 | 107 | 128 | 128 |
| 14 | | | | | | |
| 13 | | | | | | |
| 12 | 88 | 94 | 93 | 106 | 116 | 125 |
| 11 | | | | | | |
| 10 | 88 | 100 | 92 | 108 | 114 | 128 |
| 9 | | | | | | |
| 8 | 96 | 103 | 103 | 106 | 123 | 130 |
| 7 | | | | | | |
| 6 | 88 | 100 | 96 | 105 | 115 | 127 |
| 5 | 86 | 100 | 96 | 111 | 114 | 120 |
| 4 | 87 | 101 | 92 | 103 | 115 | 128 |
| 3 | 89 | 100 | 93 | 109 | 113 | 127 |
| 2 | | | | | | |
| 1 | | | | | | |
| Basement | | | | | | |

Table B-5. Mean Path Losses for Each High-rise Building

| Transmission Path | Frequency (MHz) | High Rise | Mean Path Loss (dB) | σ (dB) |
|-------------------|-----------------|-----------|---------------------|---------------|
| LOS | 912 | 1 | 91.8 | 8.8 |
| | | 2 | 79.7 | 9.4 |
| | | 3 | 84.1 | 12.5 |
| | | 4 | 88.7 | 12.1 |
| | 1920 | 1 | 96.8 | 9.6 |
| | | 2 | 90.7 | 11.1 |
| | | 3 | 93.8 | 14.5 |
| | | 4 | 94.5 | 14.3 |
| | 5990 | 1 | 112.5 | 9.4 |
| | | 2 | 105.8 | 11.0 |
| | | 3 | 111.7 | 14.5 |
| | | 4 | 115.5 | 13.0 |
| NLOS | 912 | 1 | 109.7 | 7.5 |
| | | 2 | 114.3 | 6.3 |
| | | 3 | 107.9 | 9.5 |
| | | 4 | 98.8 | 10.7 |
| | 1920 | 1 | 116.7 | 8.2 |
| | | 2 | 128.1 | 7.7 |
| | | 3 | 118.7 | 10.9 |
| | | 4 | 106.8 | 10.8 |
| | 5990 | 1 | 136.3 | 7.2 |
| | | 2 | 143.8 | 7.0 |
| | | 3 | 136.7 | 9.3 |
| | | 4 | 127.5 | 8.8 |

Table B-6. Mean Path Losses for All High-rise Buildings (Calculated From Table B-5)

| Path | Frequency (MHz) | Mean Path Loss (dB) |
|------|-----------------|---------------------|
| LOS | 912 | 83.8 |
| NLOS | | 103.9 |
| Both | | 86.8 |
| LOS | 1920 | 93.4 |
| NLOS | | 112.1 |
| Both | | 96.3 |
| LOS | 5990 | 109.8 |
| NLOS | | 132.5 |
| Both | | 112.8 |