

**Table S1.** Description of *TP53* gene mutations and loss of the wild type *TP53* allele in New Zealand breast tumor cohort

| Sample name | <i>TP53</i> Mutation    | cDNA info                                            | COSMIC ID   | Mutation Type     | Mutant allele frequency <sup>1</sup> | <i>TP53</i> LOH <sup>2</sup> |
|-------------|-------------------------|------------------------------------------------------|-------------|-------------------|--------------------------------------|------------------------------|
| BC0009R     | p.S46*fs*1              | c.137_141delCCCCG                                    |             | Frameshift        | 20%                                  | Yes                          |
| AL0014      | p.E51Vfs*4              | c.152_156delAACAA                                    |             | Frameshift        | 20%                                  | No                           |
| AL0088      | p.P82Rfs*41             | c.245delC                                            |             | Frameshift        | 74%                                  | No                           |
| AL0027      | p.G105V                 | c.314G>T                                             | COSM46161   | Missense          | 36%                                  | No                           |
| AL0011      | p.R110P                 | c.329G>C                                             | COSM11250   | Missense          | 29%                                  | Yes                          |
| AL0039      | p.R110Pfs*39            | c.328dup                                             | COSM96579   | Frameshift        | 29%                                  | No                           |
| BC0003      | p.N131fs                | c.393delTCTTGGCCAGTT<br>GGCAAAACATCTTGTGA<br>GGGCAGG |             | Frameshift        | 13%                                  | No                           |
| AL0021      | inside intron 4         | c.375+1G>A                                           | COSM45304   | Splicing          | 58%                                  | Yes                          |
| AL0060      | inside intron 4         | c.375+5G>A                                           | COSM6222489 | Splicing          | 53%                                  | No                           |
| AL0001      | p.P151S                 | c.451C>T                                             | COSM10905   | Missense          | 50%                                  | No                           |
| AL0067      | p.P151R                 | c.452C>G                                             | COSM44003   | Missense          | 52%                                  | Yes                          |
| BC0043      | p.C176Y                 | c.527G>A                                             | COSM10687   | Missense          | 23%                                  | No                           |
| AL0069      | p.H179D                 | c.535C>G                                             | COSM44776   | Missense          | 34%                                  | No                           |
| AL0068      | inside intron 5         | c.560-1G>A                                           | COSM43753   | Splicing          | 13%                                  | No                           |
| AL0078      | p.R213*                 | c.637C>T                                             | COSM10654   | Nonsense          | 17%                                  | No                           |
| AL0065      | p.Y220C                 | c.659A>G                                             | COSM10758   | Missense          | 23%                                  | Yes                          |
| AL0063      | p.Y220C                 | c.659A>G                                             | COSM10758   | Missense          | 46%                                  | No                           |
| AL0043      | p.Y234fs*4              | c.699-700insTGGA                                     |             | Frameshift        | 19%                                  | No                           |
| BC0010      | p.M237I                 | c.711G>T                                             | COSM11063   | Missense          | 35%                                  | No                           |
| AL0057      | p.I251N                 | c.752T>A                                             | COSM11374   | Missense          | 62%                                  | No                           |
| AL0007      | p.I255delI              | c.764_766delTCA                                      | COSM43694   | In-Frame Deletion | 79%                                  | Yes                          |
| AL0062      | p.D259V                 | c.776A>T                                             | COSM43724   | Missense          | 27%                                  | No                           |
| AL0034      | from exon 7 to intron 7 | c.769_782+7delCTGGAA<br>GACTCCAGGTCAGGA              |             | Splicing          | 32%                                  | No                           |
| AL0073      | inside intron 7         | c.782+1G>A                                           | COSM43571   | Splicing          | 39%                                  | No                           |
| BC0006      | p.N263Rfs*80            | c.788_794delATCTACT                                  |             | Frameshift        | 59%                                  | No                           |
| BC0020      | p.R267W                 | c.799C>T                                             | COSM11183   | Missense          | 29%                                  | No                           |
| BC0019      | p.P278A                 | c.832C>G                                             | COSM10814   | Missense          | 57%                                  | No                           |
| AL0029      | p.E286K                 | c.856G>A                                             | COSM10726   | Missense          | 44%                                  | No                           |
| AL0013      | p.Y327Ffs*9             | c.980_981delAT                                       | COSM45832   | Frameshift        | 38%                                  | No                           |
| AL0086      | p.E339*                 | c.1015G>T                                            | COSM11286   | Nonsense          | 40%                                  | Yes                          |
| AL0042      | p.R342*                 | c.1024C>T                                            | COSM11073   | Nonsense          | 50%                                  | Yes                          |

<sup>1</sup>not adjusted for tumor cellularity, <sup>2</sup>LOH = likely loss of heterozygosity

**Table S2.** Association of *TP53* tumor information with clinical, pathological and intrinsic subtype information in New Zealand breast tumor cohort. Table shows *p* values, with significant *p* values highlighted in bold.

| <i>TP53</i> transcript information | Breast cancer subtype        | Tumor ER status              | Tumor PgR status             | Histological Grade           | Patient Age  | Patient LN status |
|------------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------|-------------------|
| <i>t1</i>                          | 0.450                        | 0.958                        | 0.771                        | 0.876                        | 0.858        | 0.952             |
| <i>t2</i>                          | 0.351                        | 0.925                        | 0.650                        | 0.815                        | 0.604        | 0.944             |
| <i>t3</i>                          | 0.134                        | <b>0.047</b>                 | 0.077                        | 0.437                        | 0.136        | 0.491             |
| <i>t4</i>                          | 0.112                        | <b>0.032</b>                 | <b>0.037</b>                 | 0.098                        | 0.516        | <b>0.043</b>      |
| <i>t5</i>                          | 0.476                        | 0.159                        | 0.159                        | 0.249                        | 0.056        | 0.170             |
| <i>t6</i>                          | 0.526                        | 0.164                        | 0.165                        | 0.258                        | <b>0.049</b> | 0.186             |
| <i>t7</i>                          | 0.404                        | 0.182                        | 0.187                        | 0.277                        | 0.091        | 0.222             |
| <i>t8</i>                          | <b>0.042</b>                 | 0.750                        | 0.830                        | 0.488                        | 0.289        | 0.406             |
| <i>t8β</i>                         | 0.447                        | 0.400                        | 0.156                        | 0.133                        | 0.558        | 0.106             |
| <i>t8γ</i>                         | 0.500                        | 0.599                        | 0.160                        | 0.256                        | 0.251        | 0.925             |
| <i>t2/t1</i>                       | 0.982                        | 0.558                        | 0.865                        | 0.887                        | 0.074        | <b>0.042</b>      |
| <i>t3/t1</i>                       | <b>9.8 x 10<sup>-5</sup></b> | <b>4.7 x 10<sup>-4</sup></b> | <b>0.001</b>                 | 0.276                        | 0.056        | 0.339             |
| <i>t4/t1</i>                       | 0.231                        | 0.113                        | 0.114                        | 0.173                        | 0.260        | 0.079             |
| <i>t5/t1</i>                       | 0.489                        | 0.157                        | 0.154                        | 0.244                        | 0.054        | 0.174             |
| <i>t6/t1</i>                       | 0.513                        | 0.164                        | 0.161                        | 0.265                        | <b>0.048</b> | 0.216             |
| <i>t7/t1</i>                       | 0.442                        | 0.176                        | 0.183                        | 0.285                        | 0.084        | 0.214             |
| <i>t8/t1</i>                       | 0.092                        | 0.970                        | 0.414                        | 0.414                        | 0.081        | 0.248             |
| <i>t8β/t1</i>                      | 0.416                        | 0.643                        | 0.108                        | 0.194                        | 0.784        | 0.213             |
| <i>t8γ/t1</i>                      | 0.452                        | 0.700                        | 0.163                        | 0.258                        | 0.215        | 0.782             |
| <i>FL/Δ40TP53_T1</i> 5' end        | 0.351                        | 0.417                        | 0.118                        | 0.195                        | 0.091        | 0.547             |
| <i>FL/Δ40TP53_T2</i> 5' end        | 0.726                        | 0.851                        | 0.640                        | 0.736                        | <b>0.034</b> | 0.520             |
| <i>Δ133TP53</i> 5' end             | 0.221                        | 0.082                        | <b>0.049</b>                 | <b>0.05</b>                  | <b>0.038</b> | 0.283             |
| <i>TP53α</i> 3' end                | 0.770                        | 0.341                        | 0.539                        | 0.796                        | 0.564        | 0.854             |
| <i>TP53β</i> 3' end                | <b>0.026</b>                 | 0.076                        | 0.057                        | 0.170                        | 0.770        | 0.699             |
| <i>TP53</i> mutation               | <b>4.7e-5</b>                | <b>1.3 x 10<sup>-4</sup></b> | <b>6.5 x 10<sup>-6</sup></b> | <b>4.4 x 10<sup>-6</sup></b> | 0.059        | 0.653             |
| <i>TP53</i> LOH                    | 0.920                        | 0.650                        | 0.703                        | 0.470                        | 0.210        | 0.610             |

ER= estrogen receptor, PgR= progesterone receptor, LN= Lymph node, LOH = loss of heterozygosity

**Table S3.** Clinical and pathological features of 89 breast cancer patients in this study; a subset of the cohort described in [24].

| <b>Clinicopathological feature</b> | <b>Mean<br/>(range)</b> | <b>Number<br/>(% of total)</b> |
|------------------------------------|-------------------------|--------------------------------|
| Patient age (years)                | 60 (31-94)              | /                              |
| Tumor size (mm)                    | 30 (6-100)              | /                              |
| Patient lymph node status          |                         |                                |
| LN+                                | /                       | 47 (53%)                       |
| LN-                                | /                       | 39 (44%)                       |
| N/A                                | /                       | 3 (3%)                         |
| Histological tumor grade           |                         |                                |
| Grade 1                            | /                       | 6 (7%)                         |
| Grade 2                            | /                       | 35 (39%)                       |
| Grade 3                            | /                       | 48 (54%)                       |
| Tumor ER status                    |                         |                                |
| ER+                                | /                       | 63 (71%)                       |
| ER-                                | /                       | 26 (29%)                       |
| Tumor PgR status                   |                         |                                |
| PgR+                               | /                       | 52 (58%)                       |
| PgR-                               | /                       | 36 (41%)                       |
| N/A                                | /                       | 1 (1%)                         |
| Breast cancer subtype              |                         |                                |
| Luminal A                          | /                       | 21 (24%)                       |
| Luminal B                          | /                       | 27 (30%)                       |
| Her2+                              | /                       | 14 (16%)                       |
| Basal-like                         | /                       | 19 (21%)                       |
| Normal-like                        | /                       | 8 (9%)                         |

LN= Lymph node, ER= estrogen receptor, PgR= progesterone receptor

**Table S4.** Results from long amplicon ddPCR assays to quantitate 10 *TP53* transcripts in breast cancer samples. Transcripts are *LRG\_321t1-t8*, and non-reference transcripts we have named *t8β* and *t8γ*. Values shown are the number of copies of each transcript/μg RNA. *TP53* transcripts are predicted to encode the following p53 isoforms; *t1* and *t2* = FL/Δ40p53α, *t3* = FL/Δ40p53β, *t4* = FL/Δ40p53γ, *t5* = Δ133/Δ160p53α, *t6* = Δ133/Δ160p53β, *t7* = Δ133/Δ160p53γ, *t8* = Δ40p53α, *t8β* = Δ40p53β, *t8γ* = Δ40p53γ.

| Sample name | <i>t1</i> | <i>t2</i> | <i>t3</i> | <i>t4</i> | <i>t5</i> | <i>t6</i> | <i>t7</i> | <i>t8</i> | <i>t8β</i> | <i>t8γ</i> |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| BC0009R     | 25752     | 638       | 654       | 0         | 65        | 0         | 0         | 208       | 35         | 0          |
| AL0014      | 184265    | 1884      | 1816      | 0         | 221       | 26        | 0         | 648       | 38         | 0          |
| AL0088      | 113667    | 801       | 1574      | 79        | 1000      | 74        | 0         | 1309      | 0          | 0          |
| AL0027      | 1431074   | 13944     | 3336      | 0         | 5903      | 423       | 11        | 6442      | 84         | 0          |
| AL0011      | 778216    | 7234      | 2407      | 0         | 3650      | 404       | 14        | 3686      | 69         | 0          |
| AL0039      | 140400    | 1524      | 3367      | 0         | 1412      | 210       | 0         | 1293      | 76         | 0          |
| AL0021      | 491586    | 4491      | 19972     | 170       | 448320    | 33117     | 232       | 4150      | 248        | 0          |
| AL0060      | 599823    | 5255      | 6007      | 76        | 478512    | 23700     | 432       | 1082      | 0          | 0          |
| AL0001      | 735612    | 5421      | 819       | 0         | 393       | 25        | 0         | 3499      | 0          | 0          |
| AL0067      | 938885    | 8856      | 2370      | 79        | 1165      | 117       | 0         | 2709      | 47         | 0          |
| BC0043      | 111553    | 618       | 507       | 0         | 329       | 12        | 0         | 259       | 0          | 0          |
| AL0069      | 1574766   | 12556     | 3443      | 70        | 1752      | 73        | 0         | 10572     | 66         | 0          |
| AL0078      | 174015    | 1633      | 2579      | 74        | 450       | 16        | 0         | 1196      | 39         | 0          |
| AL0063      | 629101    | 5926      | 764       | 0         | 449       | 120       | 0         | 17184     | 356        | 0          |
| AL0065      | 259254    | 2200      | 282       | 0         | 253       | 77        | 0         | 5979      | 448        | 0          |
| AL0043      | 354623    | 3654      | 3037      | 0         | 285       | 36        | 0         | 1253      | 76         | 0          |
| BC0010      | 193327    | 2476      | 86        | 0         | 449       | 12        | 0         | 1184      | 0          | 0          |
| AL0057      | 458532    | 4185      | 1653      | 83        | 410       | 23        | 0         | 1510      | 41         | 0          |
| AL0062      | 50118     | 726       | 85        | 0         | 141       | 12        | 0         | 275       | 0          | 0          |
| AL0034      | 307482    | 2739      | 1501      | 79        | 75        | 15        | 0         | 1382      | 36         | 0          |
| AL0007      | 1088618   | 10954     | 6961      | 158       | 1169      | 91        | 0         | 8450      | 152        | 0          |
| BC0020      | 25298     | 496       | 169       | 0         | 14        | 0         | 0         | 70        | 0          | 0          |
| BC0019      | 285164    | 3171      | 303       | 0         | 138       | 0         | 0         | 2024      | 0          | 0          |
| AL0029      | 703912    | 7882      | 1125      | 0         | 148       | 12        | 0         | 1553      | 0          | 0          |
| AL0013      | 107760    | 1323      | 1532      | 0         | 97        | 36        | 0         | 184       | 0          | 0          |
| AL0086      | 545126    | 4744      | 3589      | 0         | 785       | 36        | 0         | 5873      | 139        | 35         |
| AL0042      | 1002802   | 8620      | 6071      | 89        | 3745      | 251       | 0         | 17169     | 714        | 0          |
| AL0002      | 510354    | 4573      | 2988      | 0         | 969       | 94        | 0         | 1903      | 68         | 0          |
| AL0003      | 507144    | 4139      | 1229      | 0         | 394       | 0         | 0         | 1953      | 0          | 0          |
| AL0004      | 433023    | 4202      | 285       | 0         | 395       | 12        | 0         | 3116      | 0          | 0          |
| AL0005      | 224411    | 2198      | 1288      | 0         | 290       | 29        | 0         | 699       | 39         | 0          |
| AL0006      | 374705    | 2918      | 82        | 0         | 119       | 12        | 0         | 2296      | 40         | 0          |
| AL0008      | 214791    | 2286      | 2358      | 0         | 388       | 315       | 0         | 1075      | 72         | 0          |
| AL0010      | 361634    | 3366      | 1400      | 0         | 133       | 97        | 0         | 2324      | 169        | 0          |
| AL0012      | 360056    | 2830      | 748       | 0         | 564       | 25        | 0         | 4578      | 114        | 0          |
| AL0015      | 593771    | 5685      | 3593      | 78        | 275       | 69        | 0         | 4725      | 171        | 0          |
| AL0017      | 117985    | 679       | 1268      | 0         | 1180      | 141       | 0         | 1898      | 107        | 0          |
| AL0018      | 182851    | 1749      | 435       | 0         | 50        | 25        | 0         | 3044      | 112        | 0          |
| AL0019      | 460994    | 3649      | 1143      | 0         | 93        | 0         | 0         | 3369      | 0          | 0          |
| AL0020      | 199157    | 1475      | 2434      | 0         | 267       | 116       | 0         | 1654      | 81         | 0          |
| AL0022      | 319407    | 3270      | 834       | 0         | 116       | 0         | 0         | 4556      | 0          | 0          |

|        |         |       |      |     |      |     |    |      |     |    |
|--------|---------|-------|------|-----|------|-----|----|------|-----|----|
| AL0023 | 455022  | 4273  | 2505 | 0   | 167  | 71  | 0  | 4279 | 34  | 0  |
| AL0024 | 297951  | 2405  | 1145 | 163 | 475  | 24  | 0  | 3895 | 40  | 0  |
| AL0025 | 497381  | 5029  | 2734 | 78  | 584  | 40  | 0  | 2556 | 0   | 0  |
| AL0026 | 329180  | 3463  | 2220 | 79  | 445  | 54  | 13 | 2795 | 36  | 0  |
| AL0028 | 365173  | 3174  | 2515 | 93  | 190  | 63  | 0  | 1532 | 39  | 0  |
| AL0030 | 18346   | 253   | 72   | 0   | 0    | 0   | 0  | 71   | 0   | 0  |
| AL0032 | 142194  | 1635  | 445  | 0   | 35   | 12  | 0  | 676  | 0   | 0  |
| AL0033 | 579293  | 5359  | 2167 | 0   | 1139 | 96  | 0  | 6508 | 80  | 0  |
| AL0035 | 182358  | 2528  | 1200 | 0   | 63   | 0   | 0  | 1113 | 0   | 0  |
| AL0036 | 948026  | 8442  | 2622 | 0   | 299  | 0   | 0  | 7435 | 0   | 0  |
| AL0037 | 647280  | 5026  | 2446 | 0   | 1558 | 166 | 0  | 4149 | 69  | 0  |
| AL0040 | 99904   | 930   | 336  | 0   | 149  | 27  | 0  | 673  | 32  | 0  |
| AL0041 | 729773  | 6755  | 2733 | 0   | 329  | 88  | 0  | 5364 | 34  | 0  |
| AL0044 | 274098  | 2614  | 5203 | 0   | 104  | 161 | 0  | 2528 | 34  | 0  |
| AL0046 | 299481  | 3093  | 2102 | 0   | 486  | 58  | 0  | 4510 | 76  | 0  |
| AL0047 | 1064689 | 9268  | 3692 | 0   | 1827 | 97  | 0  | 4516 | 63  | 0  |
| AL0048 | 424828  | 3261  | 1796 | 82  | 139  | 35  | 12 | 1144 | 35  | 0  |
| AL0049 | 1406952 | 11926 | 2376 | 0   | 606  | 23  | 0  | 6812 | 75  | 0  |
| AL0050 | 536942  | 4165  | 5226 | 0   | 661  | 139 | 0  | 867  | 0   | 0  |
| AL0051 | 244428  | 1986  | 1894 | 146 | 82   | 23  | 0  | 731  | 0   | 0  |
| AL0052 | 415262  | 3823  | 4794 | 0   | 122  | 24  | 0  | 2423 | 98  | 33 |
| AL0053 | 281597  | 3264  | 2475 | 0   | 87   | 12  | 0  | 2539 | 0   | 0  |
| AL0054 | 718424  | 5439  | 6435 | 0   | 436  | 97  | 0  | 3729 | 0   | 0  |
| AL0056 | 169021  | 1855  | 1081 | 0   | 867  | 115 | 0  | 743  | 87  | 0  |
| AL0058 | 995838  | 9224  | 4222 | 86  | 432  | 23  | 0  | 5037 | 119 | 0  |
| AL0061 | 612785  | 5971  | 2020 | 75  | 895  | 82  | 0  | 7221 | 39  | 0  |
| AL0070 | 107826  | 1119  | 1838 | 0   | 123  | 61  | 0  | 687  | 0   | 0  |
| AL0071 | 629630  | 6573  | 1961 | 0   | 257  | 82  | 0  | 1750 | 0   | 0  |
| AL0072 | 308586  | 3364  | 1478 | 0   | 170  | 24  | 0  | 1276 | 34  | 0  |
| AL0074 | 87490   | 727   | 324  | 0   | 200  | 0   | 0  | 315  | 0   | 0  |
| AL0075 | 431040  | 3869  | 1320 | 0   | 135  | 51  | 0  | 2700 | 67  | 0  |
| AL0077 | 27516   | 101   | 273  | 0   | 0    | 0   | 0  | 68   | 0   | 0  |
| AL0079 | 363819  | 3625  | 634  | 0   | 0    | 0   | 0  | 1997 | 0   | 0  |
| AL0087 | 663337  | 6170  | 4987 | 0   | 185  | 12  | 0  | 3118 | 107 | 0  |
| BC0015 | 34029   | 285   | 394  | 79  | 36   | 12  | 0  | 67   | 0   | 0  |
| BC0050 | 272193  | 3121  | 190  | 0   | 225  | 0   | 0  | 1040 | 0   | 0  |