# APPENDIX 6.11-D – OPERATIONAL LOS WORKSHEETS

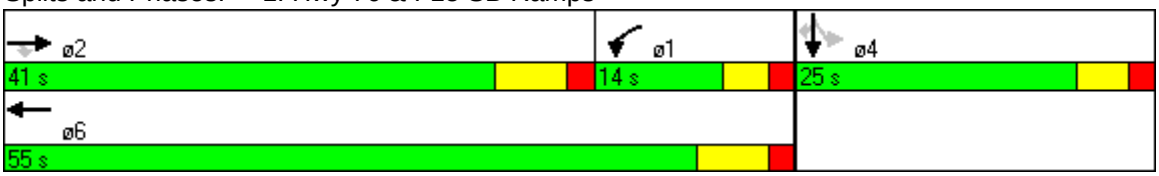
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Leading Detector (ft) | | 50 | 50 | 50 | 50 | | | | | 50 | 50 | 50 |
| Trailing Detector (ft) | | 0 | 0 | 0 | 0 | | | | | 0 | 0 | 0 |
| Turning Speed (mph) | 15 | | 9 | 15 | | 9 | 15 | | 9 | 15 | | 9 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | | 0.954 | |
| Satd. Flow (prot) | 0 | 1827 | 1553 | 1719 | 1810 | 0 | 0 | 0 | 0 | 0 | 1726 | 1538 |
| Flt Permitted | | | | 0.950 | | | | | | | 0.954 | |
| Satd. Flow (perm) | 0 | 1827 | 1553 | 1719 | 1810 | 0 | 0 | 0 | 0 | 0 | 1726 | 1538 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 376 | | | | | | | | | 524 |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Link Speed (mph) | | 55 | | | 55 | | | 55 | | | 55 | |
| Link Distance (ft) | | 1319 | | | 1472 | | | 1103 | | | 2482 | |
| Travel Time (s) | | 16.4 | | | 18.2 | | | 13.7 | | | 30.8 | |
| Volume (vph) | 0 | 638 | 331 | 154 | 320 | 0 | 0 | 0 | 0 | 132 | 6 | 616 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Heavy Vehicles (%) | 4% | 4% | 4% | 5% | 5% | 5% | 2% | 2% | 2% | 5% | 5% | 5% |
| Adj. Flow (vph) | 0 | 725 | 376 | 175 | 364 | 0 | 0 | 0 | 0 | 150 | 7 | 700 |
| Lane Group Flow (vph) | 0 | 725 | 376 | 175 | 364 | 0 | 0 | 0 | 0 | 0 | 157 | 700 |
| Turn Type | | | Perm | Prot | | | | | | Perm | | Perm |
| Protected Phases | | 2 | | 1 | 6 | | | | | | 4 | |
| Permitted Phases | | | 2 | | | | | | | 4 | | 4 |
| Detector Phases | | 2 | 2 | 1 | 6 | | | | | 4 | 4 | 4 |
| Minimum Initial (s) | | 5.0 | 5.0 | 5.0 | 5.0 | | | | | 5.0 | 5.0 | 5.0 |
| Minimum Split (s) | | 22.0 | 22.0 | 10.2 | 24.0 | | | | | 22.0 | 22.0 | 22.0 |
| Total Split (s) | 0.0 | 41.0 | 41.0 | 14.0 | 55.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25.0 | 25.0 | 25.0 |
| Total Split (%) | 0.0% | 51.3% | 51.3% | 17.5% | 68.8% | 0.0% | 0.0% | 0.0% | 0.0% | 31.3% | 31.3% | 31.3% |
| Maximum Green (s) | | 34.0 | 34.0 | 8.8 | 48.0 | | | | | 19.4 | 19.4 | 19.4 |
| Yellow Time (s) | | 5.0 | 5.0 | 3.2 | 5.0 | | | | | 3.6 | 3.6 | 3.6 |
| All-Red Time (s) | | 2.0 | 2.0 | 2.0 | 2.0 | | | | | 2.0 | 2.0 | 2.0 |
| Lead/Lag | | Lead | Lead | Lag | | | | | | | | |
| Lead-Lag Optimize? | | Yes | Yes | Yes | | | | | | | | |
| Vehicle Extension (s) | | 3.0 | 3.0 | 3.0 | 3.0 | | | | | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | | 2.0 | 2.0 | 2.0 | 2.0 | | | | | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | | 0.0 | 0.0 | 0.5 | 0.0 | | | | | 0.0 | 0.0 | 0.0 |
| Time To Reduce (s) | | 0.0 | 0.0 | 0.1 | 0.0 | | | | | 0.0 | 0.0 | 0.0 |
| Recall Mode | | C-Min | C-Min | Min | C-Max | | | | | Min | Min | Min |
| Walk Time (s) | | | | | 7.0 | | | | | | | |
| Flash Dont Walk (s) | | | | | 10.0 | | | | | | | |
| Pedestrian Calls (#/hr) | | | | | 10 | | | | | | | |
| Act Effct Green (s) | | 38.4 | 38.4 | 11.3 | 53.7 | | | | | | 18.3 | 18.3 |
| Actuated g/C Ratio | | 0.48 | 0.48 | 0.14 | 0.67 | | | | | | 0.23 | 0.23 |
| v/c Ratio | | 0.83 | 0.40 | 0.72 | 0.30 | | | | | | 0.40 | 0.93 |
| Control Delay | | 28.6 | 2.9 | 43.5 | 0.7 | | | | | | 28.4 | 28.0 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | 0.0 | 0.0 |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Delay | | 28.6 | 2.9 | 43.5 | 0.7 | | | | | | 28.4 | 28.0 |
| LOS | | C | A | D | A | | | | | | C | C |
| Approach Delay | | 19.8 | | | 14.6 | | | | | | 28.0 | |
| Approach LOS | | B | | | B | | | | | | C | |
| Queue Length 50th (ft) | | 309 | 0 | 97 | 0 | | | | | | 64 | 79 |
| Queue Length 95th (ft) | | #503 | 40 | m#186 | 0 | | | | | | 113 | #292 |
| Internal Link Dist (ft) | | 1239 | | | 1392 | | | 1023 | | | 2402 | |
| Turn Bay Length (ft) | | | | | | | | | | | | |
| Base Capacity (vph) | | 878 | 941 | 243 | 1216 | | | | | | 453 | 790 |
| Starvation Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Spillback Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Storage Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Reduced v/c Ratio | | 0.83 | 0.40 | 0.72 | 0.30 | | | | | | 0.35 | 0.89 |

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 40 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 21.5 Intersection LOS: C
Intersection Capacity Utilization 63.0% ICU Level of Service B
Analysis Period (min) 15
# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Leading Detector (ft) | | 50 | 50 | 50 | 50 | | | | | 50 | 50 | 50 |
| Trailing Detector (ft) | | 0 | 0 | 0 | 0 | | | | | 0 | 0 | 0 |
| Turning Speed (mph) | 15 | | 9 | 15 | | 9 | 15 | | 9 | 15 | | 9 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | | 0.953 | |
| Satd. Flow (prot) | 0 | 1863 | 1583 | 1770 | 1863 | 0 | 0 | 0 | 0 | 0 | 1775 | 1583 |
| Flt Permitted | | | | 0.950 | | | | | | | 0.953 | |
| Satd. Flow (perm) | 0 | 1863 | 1583 | 1770 | 1863 | 0 | 0 | 0 | 0 | 0 | 1775 | 1583 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 164 | | | | | | | | | 117 |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Link Speed (mph) | | 30 | | | 30 | | | 55 | | | 55 | |
| Link Distance (ft) | | 1319 | | | 1472 | | | 1103 | | | 2482 | |
| Travel Time (s) | | 30.0 | | | 33.5 | | | 13.7 | | | 30.8 | |
| Volume (vph) | 0 | 972 | 257 | 190 | 892 | 0 | 0 | 0 | 0 | 158 | 2 | 664 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Adj. Flow (vph) | 0 | 1105 | 292 | 216 | 1014 | 0 | 0 | 0 | 0 | 180 | 2 | 755 |
| Lane Group Flow (vph) | 0 | 1105 | 292 | 216 | 1014 | 0 | 0 | 0 | 0 | 0 | 182 | 755 |
| Turn Type | | | Perm | Prot | | | | | | Perm | | Perm |
| Protected Phases | | 4 | | 3 | 8 | | | | | | 6 | |
| Permitted Phases | | | 4 | | | | | | | 6 | | 6 |
| Detector Phases | | 4 | 4 | 3 | 8 | | | | | 6 | 6 | 6 |
| Minimum Initial (s) | | 5.0 | 5.0 | 4.0 | 4.0 | | | | | 5.0 | 5.0 | 5.0 |
| Minimum Split (s) | | 22.0 | 22.0 | 10.0 | 22.0 | | | | | 24.0 | 24.0 | 24.0 |
| Total Split (s) | 0.0 | 60.0 | 60.0 | 16.0 | 76.0 | 0.0 | 0.0 | 0.0 | 0.0 | 44.0 | 44.0 | 44.0 |
| Total Split (%) | 0.0% | 50.0% | 50.0% | 13.3% | 63.3% | 0.0% | 0.0% | 0.0% | 0.0% | 36.7% | 36.7% | 36.7% |
| Maximum Green (s) | | 54.4 | 54.4 | 10.0 | 70.0 | | | | | 37.0 | 37.0 | 37.0 |
| Yellow Time (s) | | 3.6 | 3.6 | 5.0 | 5.0 | | | | | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | | 2.0 | 2.0 | 1.0 | 1.0 | | | | | 2.0 | 2.0 | 2.0 |
| Lead/Lag | | Lead | Lead | Lag | | | | | | | | |
| Lead-Lag Optimize? | | Yes | Yes | Yes | | | | | | | | |
| Vehicle Extension (s) | | 3.0 | 3.0 | 3.0 | 3.0 | | | | | 3.0 | 3.0 | 3.0 |
| Recall Mode | | C-Min | C-Min | None | C-Max | | | | | None | None | None |
| Walk Time (s) | | | | | | | | | | 7.0 | 7.0 | 7.0 |
| Flash Dont Walk (s) | | | | | | | | | | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | | | | | | | | | | 10 | 10 | 10 |
| Act Effct Green (s) | | 56.0 | 56.0 | 12.0 | 72.0 | | | | | | 40.0 | 40.0 |
| Actuated g/C Ratio | | 0.47 | 0.47 | 0.10 | 0.60 | | | | | | 0.33 | 0.33 |
| v/c Ratio | | 1.27 | 0.35 | 1.22 | 0.91 | | | | | | 0.31 | 1.25 |
| Control Delay | | 161.1 | 9.8 | 135.3 | 3.9 | | | | | | 31.5 | 154.4 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | 0.0 | 0.0 |
| Total Delay | | 161.1 | 9.8 | 135.3 | 3.9 | | | | | | 31.5 | 154.4 |
| LOS | | F | A | F | A | | | | | | C | F |
| Approach Delay | | 129.5 | | | 27.0 | | | | | | 130.5 | |
| Approach LOS | | F | | | C | | | | | | F | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Queue Length 50th (ft) | | ~1080 | 56 | ~202 | 1 | | | | | | 104 | ~668 |
| Queue Length 95th (ft) | | #1292 | 113 | m#153 | m0 | | | | | | 162 | #878 |
| Internal Link Dist (ft) | | 1239 | | | 1392 | | | 1023 | | | 2402 | |
| Turn Bay Length (ft) | | | | | | | | | | | | |
| Base Capacity (vph) | | 869 | 826 | 177 | 1118 | | | | | | 592 | 606 |
| Starvation Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Spillback Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Storage Cap Reductn | | 0 | 0 | 0 | 0 | | | | | | 0 | 0 |
| Reduced v/c Ratio | | 1.27 | 0.35 | 1.22 | 0.91 | | | | | | 0.31 | 1.25 |

Intersection Summary

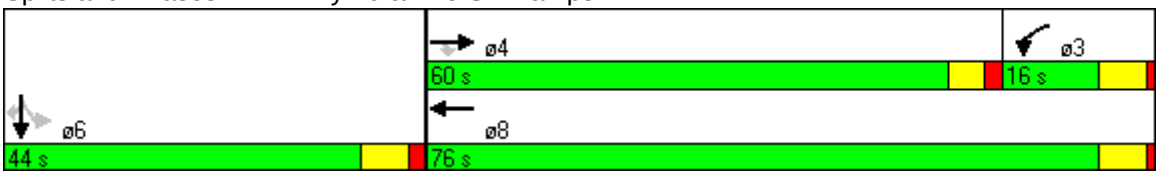
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 58 (48%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 150
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.27
Intersection Signal Delay: 94.4 Intersection LOS: F
Intersection Capacity Utilization 102.3% ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



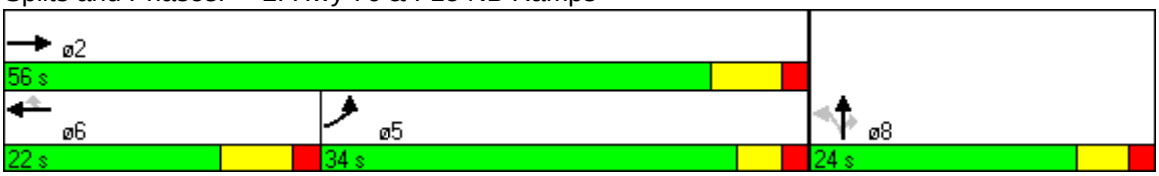
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Leading Detector (ft) | 50 | 50 | | | 50 | 50 | 50 | 50 | 50 | | | |
| Trailing Detector (ft) | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | | | |
| Turning Speed (mph) | 15 | | 9 | 15 | | 9 | 15 | | 9 | 15 | | 9 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | | 0.953 | | | | |
| Satd. Flow (prot) | 1736 | 1827 | 0 | 0 | 1863 | 1583 | 0 | 1646 | 1468 | 0 | 0 | 0 |
| Flt Permitted | 0.950 | | | | | | | 0.953 | | | | |
| Satd. Flow (perm) | 1736 | 1827 | 0 | 0 | 1863 | 1583 | 0 | 1646 | 1468 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 91 | | | 247 | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Link Speed (mph) | | 55 | | | 55 | | | 55 | | | 55 | |
| Link Distance (ft) | | 1472 | | | 1051 | | | 1885 | | | 903 | |
| Travel Time (s) | | 18.2 | | | 13.0 | | | 23.4 | | | 11.2 | |
| Volume (vph) | 497 | 273 | 0 | 0 | 291 | 80 | 182 | 1 | 217 | 0 | 0 | 0 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Heavy Vehicles (%) | 4% | 4% | 4% | 2% | 2% | 2% | 10% | 10% | 10% | 2% | 2% | 2% |
| Adj. Flow (vph) | 565 | 310 | 0 | 0 | 331 | 91 | 207 | 1 | 247 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 565 | 310 | 0 | 0 | 331 | 91 | 0 | 208 | 247 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | Perm | | | |
| Protected Phases | 5 | 2 | | | 6 | | | 8 | | | | |
| Permitted Phases | | | | | | 6 | 8 | | 8 | | | |
| Detector Phases | 5 | 2 | | | 6 | 6 | 8 | 8 | 8 | | | |
| Minimum Initial (s) | 5.0 | 5.0 | | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | | | |
| Minimum Split (s) | 12.0 | 22.0 | | | 22.0 | 22.0 | 24.0 | 24.0 | 24.0 | | | |
| Total Split (s) | 34.0 | 56.0 | 0.0 | 0.0 | 22.0 | 22.0 | 24.0 | 24.0 | 24.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 42.5% | 70.0% | 0.0% | 0.0% | 27.5% | 27.5% | 30.0% | 30.0% | 30.0% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 28.8 | 49.0 | | | 15.0 | 15.0 | 18.4 | 18.4 | 18.4 | | | |
| Yellow Time (s) | 3.2 | 5.0 | | | 5.0 | 5.0 | 3.6 | 3.6 | 3.6 | | | |
| All-Red Time (s) | 2.0 | 2.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | | |
| Lead/Lag | Lag | | | | Lead | Lead | | | | | | |
| Lead-Lag Optimize? | Yes | | | | Yes | Yes | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | | |
| Minimum Gap (s) | 3.0 | 3.0 | | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | | |
| Time Before Reduce (s) | 0.5 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Time To Reduce (s) | 0.1 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Recall Mode | None | C-Max | | | C-Max | C-Max | Min | Min | Min | | | |
| Walk Time (s) | | | | | | | 7.0 | 7.0 | 7.0 | | | |
| Flash Dont Walk (s) | | | | | | | 10.0 | 10.0 | 10.0 | | | |
| Pedestrian Calls (#/hr) | | | | | | | 10 | 10 | 10 | | | |
| Act Effct Green (s) | 30.0 | 56.0 | | | 22.0 | 22.0 | | 16.0 | 16.0 | | | |
| Actuated g/C Ratio | 0.38 | 0.70 | | | 0.28 | 0.28 | | 0.20 | 0.20 | | | |
| v/c Ratio | 0.87 | 0.24 | | | 0.65 | 0.18 | | 0.63 | 0.50 | | | |
| Control Delay | 23.3 | 1.0 | | | 34.5 | 7.2 | | 37.6 | 7.5 | | | |
| Queue Delay | 0.0 | 0.0 | | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Delay | 23.3 | 1.0 | | | 34.5 | 7.2 | | 37.6 | 7.5 | | | |
| LOS | C | A | | | C | A | | D | A | | | |
| Approach Delay | | 15.4 | | | 28.6 | | | 21.2 | | | | |
| Approach LOS | | B | | | C | | | C | | | | |
| Queue Length 50th (ft) | 192 | 1 | | | 146 | 0 | | 95 | 0 | | | |
| Queue Length 95th (ft) | m#373 | m16 | | | #273 | 33 | | 151 | 50 | | | |
| Internal Link Dist (ft) | | 1392 | | | 971 | | | 1805 | | | 823 | |
| Turn Bay Length (ft) | | | | | | | | | | | | |
| Base Capacity (vph) | 651 | 1278 | | | 511 | 501 | | 412 | 552 | | | |
| Starvation Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Spillback Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Storage Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Reduced v/c Ratio | 0.87 | 0.24 | | | 0.65 | 0.18 | | 0.50 | 0.45 | | | |

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 24 (30%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 20.1 Intersection LOS: C
Intersection Capacity Utilization 63.0% ICU Level of Service B
Analysis Period (min) 15
# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Leading Detector (ft) | 50 | 50 | | | 50 | 50 | 50 | 50 | 50 | | | |
| Trailing Detector (ft) | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | | | |
| Turning Speed (mph) | 15 | | 9 | 15 | | 9 | 15 | | 9 | 15 | | 9 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | | 0.953 | | | | |
| Satd. Flow (prot) | 1770 | 1863 | 0 | 0 | 1863 | 1583 | 0 | 1775 | 1583 | 0 | 0 | 0 |
| Flt Permitted | 0.950 | | | | | | | 0.953 | | | | |
| Satd. Flow (perm) | 1770 | 1863 | 0 | 0 | 1863 | 1583 | 0 | 1775 | 1583 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 149 | | | 214 | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Link Speed (mph) | | 30 | | | 30 | | | 55 | | | 55 | |
| Link Distance (ft) | | 1472 | | | 1051 | | | 1885 | | | 903 | |
| Travel Time (s) | | 33.5 | | | 23.9 | | | 23.4 | | | 11.2 | |
| Volume (vph) | 605 | 525 | 0 | 0 | 528 | 171 | 553 | 6 | 253 | 0 | 0 | 0 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Adj. Flow (vph) | 688 | 597 | 0 | 0 | 600 | 194 | 628 | 7 | 288 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 688 | 597 | 0 | 0 | 600 | 194 | 0 | 635 | 288 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | Perm | | | |
| Protected Phases | 7 | 4 | | | 8 | | | 2 | | | | |
| Permitted Phases | | | | | | 8 | 2 | | 2 | | | |
| Detector Phases | 7 | 4 | | | 8 | 8 | 2 | 2 | 2 | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | | | |
| Minimum Split (s) | 10.0 | 22.0 | | | 24.0 | 24.0 | 22.0 | 22.0 | 22.0 | | | |
| Total Split (s) | 42.0 | 80.0 | 0.0 | 0.0 | 38.0 | 38.0 | 40.0 | 40.0 | 40.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 35.0% | 66.7% | 0.0% | 0.0% | 31.7% | 31.7% | 33.3% | 33.3% | 33.3% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 36.0 | 74.0 | | | 32.4 | 32.4 | 33.0 | 33.0 | 33.0 | | | |
| Yellow Time (s) | 5.0 | 5.0 | | | 3.6 | 3.6 | 5.0 | 5.0 | 5.0 | | | |
| All-Red Time (s) | 1.0 | 1.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | | |
| Lead/Lag | Lead | | | | Lag | Lag | | | | | | |
| Lead-Lag Optimize? | Yes | | | | Yes | Yes | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | | |
| Recall Mode | None | C-Max | | | C-Min | C-Min | None | None | None | | | |
| Walk Time (s) | | | | | 7.0 | 7.0 | | | | | | |
| Flash Dont Walk (s) | | | | | 10.0 | 10.0 | | | | | | |
| Pedestrian Calls (#/hr) | | | | | 10 | 10 | | | | | | |
| Act Effct Green (s) | 38.0 | 76.0 | | | 34.0 | 34.0 | | 36.0 | 36.0 | | | |
| Actuated g/C Ratio | 0.32 | 0.63 | | | 0.28 | 0.28 | | 0.30 | 0.30 | | | |
| v/c Ratio | 1.23 | 0.51 | | | 1.14 | 0.35 | | 1.19 | 0.46 | | | |
| Control Delay | 129.6 | 4.7 | | | 122.3 | 11.3 | | 141.4 | 11.9 | | | |
| Queue Delay | 0.0 | 0.0 | | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| Total Delay | 129.6 | 4.7 | | | 122.3 | 11.3 | | 141.4 | 11.9 | | | |
| LOS | F | A | | | F | B | | F | B | | | |
| Approach Delay | | 71.5 | | | 95.1 | | | 101.0 | | | | |
| Approach LOS | | E | | | F | | | F | | | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Queue Length 50th (ft) | ~645 | 101 | | | ~542 | 26 | | ~594 | 42 | | | |
| Queue Length 95th (ft) | m#431 | m100 | | | #738 | 82 | | #794 | 113 | | | |
| Internal Link Dist (ft) | | 1392 | | | 971 | | | 1805 | | | 823 | |
| Turn Bay Length (ft) | | | | | | | | | | | | |
| Base Capacity (vph) | 561 | 1180 | | | 528 | 555 | | 533 | 625 | | | |
| Starvation Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Spillback Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Storage Cap Reductn | 0 | 0 | | | 0 | 0 | | 0 | 0 | | | |
| Reduced v/c Ratio | 1.23 | 0.51 | | | 1.14 | 0.35 | | 1.19 | 0.46 | | | |

Intersection Summary

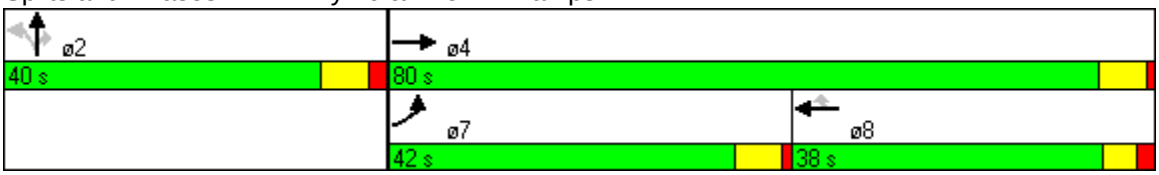
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.23
Intersection Signal Delay: 86.8 Intersection LOS: F
Intersection Capacity Utilization 102.3% ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 13 | 402 | 237 | 4 | 14 | 21 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 14 | 437 | 258 | 4 | 15 | 23 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 262 | | | | 725 | 260 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 262 | | | | 725 | 260 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 99 | | | | 96 | 97 |
| cM capacity (veh/h) | 1297 | | | | 388 | 779 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 451 | 262 | 38 |
| Volume Left | 14 | 0 | 15 |
| Volume Right | 0 | 4 | 23 |
| cSH | 1297 | 1700 | 555 |
| Volume to Capacity | 0.01 | 0.15 | 0.07 |
| Queue Length 95th (ft) | 1 | 0 | 6 |
| Control Delay (s) | 0.4 | 0.0 | 12.0 |
| Lane LOS | A | | B |
| Approach Delay (s) | 0.4 | 0.0 | 12.0 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.8 | | |
| Intersection Capacity Utilization | 41.7% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 22 | 347 | 505 | 10 | 7 | 13 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 24 | 377 | 549 | 11 | 8 | 14 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 560 | | | | 979 | 554 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 560 | | | | 979 | 554 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 97 | 97 |
| cM capacity (veh/h) | 1011 | | | | 271 | 532 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 401 | 560 | 22 |
| Volume Left | 24 | 0 | 8 |
| Volume Right | 0 | 11 | 14 |
| cSH | 1011 | 1700 | 398 |
| Volume to Capacity | 0.02 | 0.33 | 0.05 |
| Queue Length 95th (ft) | 2 | 0 | 4 |
| Control Delay (s) | 0.8 | 0.0 | 14.6 |
| Lane LOS | A | | B |
| Approach Delay (s) | 0.8 | 0.0 | 14.6 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.6 | | |
| Intersection Capacity Utilization | 46.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 10 | 378 | 215 | 1 | 0 | 4 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 11 | 411 | 234 | 1 | 0 | 4 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 235 | | | | 667 | 234 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 235 | | | | 667 | 234 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 99 | | | | 100 | 99 |
| cM capacity (veh/h) | 1333 | | | | 421 | 805 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 422 | 235 | 4 |
| Volume Left | 11 | 0 | 0 |
| Volume Right | 0 | 1 | 4 |
| cSH | 1333 | 1700 | 805 |
| Volume to Capacity | 0.01 | 0.14 | 0.01 |
| Queue Length 95th (ft) | 1 | 0 | 0 |
| Control Delay (s) | 0.3 | 0.0 | 9.5 |
| Lane LOS | A | | A |
| Approach Delay (s) | 0.3 | 0.0 | 9.5 |
| Approach LOS | | | A |

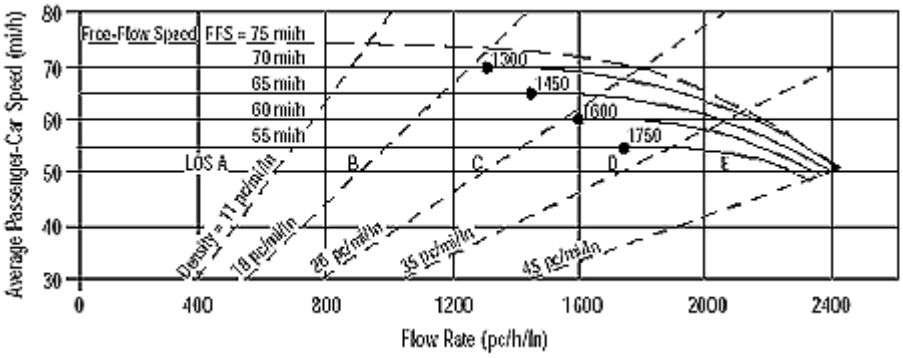
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.2 | | |
| Intersection Capacity Utilization | 37.9% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 7 | 323 | 507 | 1 | 1 | 9 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 8 | 351 | 551 | 1 | 1 | 10 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 552 | | | | 918 | 552 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 552 | | | | 918 | 552 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 99 | | | | 100 | 98 |
| cM capacity (veh/h) | 1018 | | | | 299 | 534 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 359 | 552 | 11 |
| Volume Left | 8 | 0 | 1 |
| Volume Right | 0 | 1 | 10 |
| cSH | 1018 | 1700 | 495 |
| Volume to Capacity | 0.01 | 0.32 | 0.02 |
| Queue Length 95th (ft) | 1 | 0 | 2 |
| Control Delay (s) | 0.3 | 0.0 | 12.4 |
| Lane LOS | A | | B |
| Approach Delay (s) | 0.3 | 0.0 | 12.4 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.2 | | |
| Intersection Capacity Utilization | 36.7% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *AM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *NB I-15* |
| From/To | *south of Hwy 76* |
| Jurisdiction | *Caltrans/Sand Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1417* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | | mi/h |
| Base free-flow Speed, BFFS | *70.0* | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | *0.0* | mi/h |
| $f_{LC}$ | *0.0* | mi/h |
| $f_{ID}$ | *0.0* | mi/h |
| $f_N$ | *0.0* | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *423* | pc/h/ln |
| S | *70.0* | mi/h |
| D = $v_p$ / S | *6.0* | pc/mi/ln |
| LOS | *A* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h |
| S | mi/h |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits23-8, 23-10 | $f_{LW}$ - Exhibit 23-4 |
| $E_T$ - Exhibits 23-8, 23-10, 23-11 | $f_{LC}$ - Exhibit 23-5 |
| $f_p$ - Page 23-12 | $f_N$ - Exhibit 23-6 |
| LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3 | $f_{ID}$ - Exhibit 23-7 |

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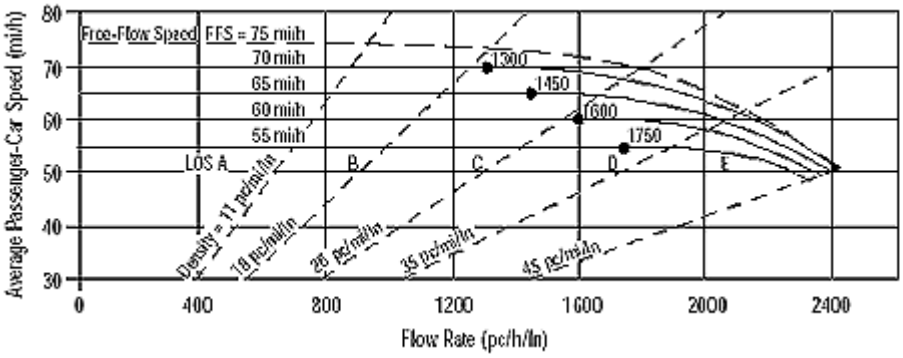
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *PM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *NB I-15* |
| From/To | *south of Hwy 76* |
| Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *7094* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2116* | pc/h/ln |
| S | *62.3* | mi/h |
| D = $v_p$ / S | *33.9* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
$v_p$ - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

$E_R$ - Exhibits23-8, 23-10
$E_T$ - Exhibits 23-8, 23-10, 23-11
$f_p$ - Page 23-12
LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3
$f_{LW}$ - Exhibit 23-4
$f_{LC}$ - Exhibit 23-5
$f_N$ - Exhibit 23-6
$f_{ID}$ - Exhibit 23-7

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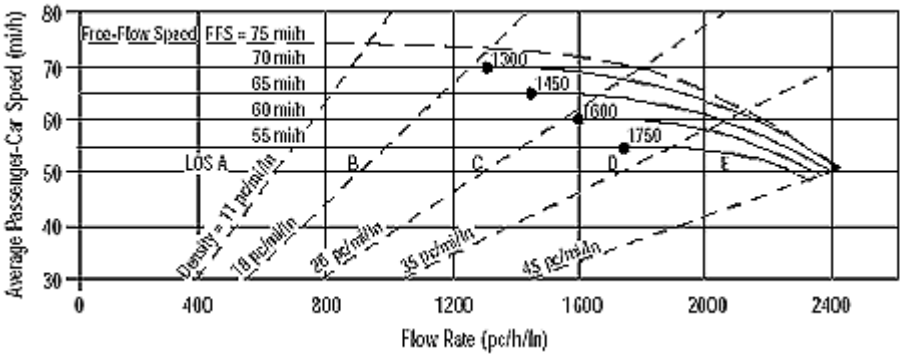
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *AM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SB I-15* |
| From/To | *south of Hwy 76* |
| Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6722* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2005* | pc/h/ln |
| S | *64.8* | mi/h |
| D = $v_p$ / S | *31.0* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits23-8, 23-10 | $f_{LW}$ - Exhibit 23-4 |
| $E_T$ - Exhibits 23-8, 23-10, 23-11 | $f_{LC}$ - Exhibit 23-5 |
| $f_p$ - Page 23-12 | $f_N$ - Exhibit 23-6 |
| LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3 | $f_{ID}$ - Exhibit 23-7 |

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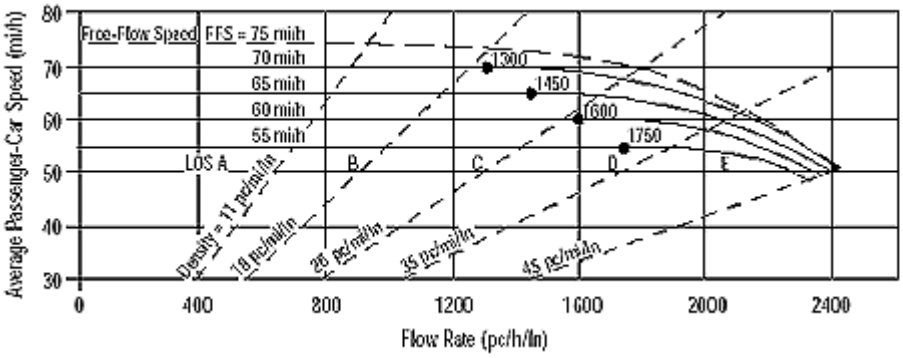
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *PM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SB I-15* |
| From/To | *south of Hwy 76* |
| Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2198* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *656* | pc/h/ln |
| S | *70.0* | mi/h |
| D = $v_p$ / S | *9.4* | pc/mi/ln |
| LOS | *A* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
$v_p$ - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits23-8, 23-10 | $f_{LW}$ - Exhibit 23-4 |
| $E_T$ - Exhibits 23-8, 23-10, 23-11 | $f_{LC}$ - Exhibit 23-5 |
| $f_p$ - Page 23-12 | $f_N$ - Exhibit 23-6 |
| LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3 | $f_{ID}$ - Exhibit 23-7 |

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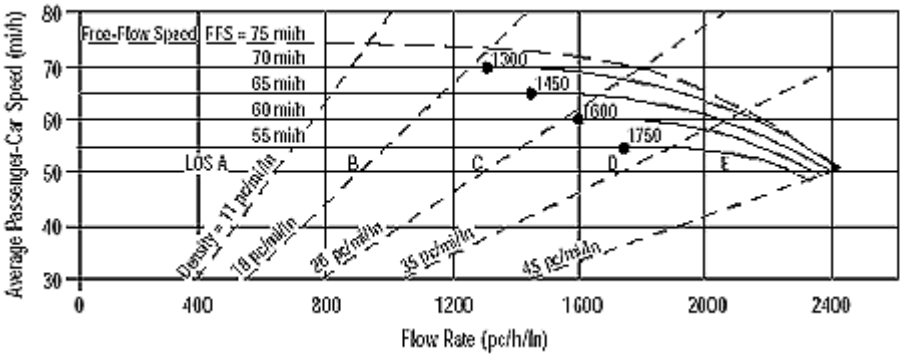
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *AM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *NB I-15* |
| From/To | *north of Hwy 76* |
| Jurisdiction | *Caltrans/Sand Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1596* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *472* | pc/h/ln |
| S | *70.0* | mi/h |
| D = $v_p$ / S | *6.7* | pc/mi/ln |
| LOS | *A* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
$v_p$ - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

$E_R$ - Exhibits23-8, 23-10
$E_T$ - Exhibits 23-8, 23-10, 23-11
$f_p$ - Page 23-12
LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3
$f_{LW}$ - Exhibit 23-4
$f_{LC}$ - Exhibit 23-5
$f_N$ - Exhibit 23-6
$f_{ID}$ - Exhibit 23-7

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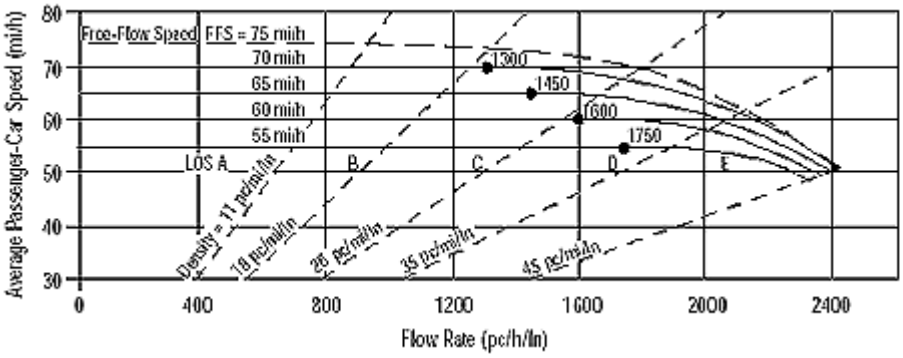
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *PM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *NB I-15* |
| From/To | *north of Hwy 76* |
| Jurisdiction | *Caltrans/Sand Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *7063* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2087* | pc/h/ln |
| S | *63.0* | mi/h |
| D = $v_p$ / S | *33.1* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
V - Hourly volume
$v_p$ - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

$E_R$ - Exhibits23-8, 23-10
$E_T$ - Exhibits 23-8, 23-10, 23-11
$f_p$ - Page 23-12
LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3
$f_{LW}$ - Exhibit 23-4
$f_{LC}$ - Exhibit 23-5
$f_N$ - Exhibit 23-6
$f_{ID}$ - Exhibit 23-7

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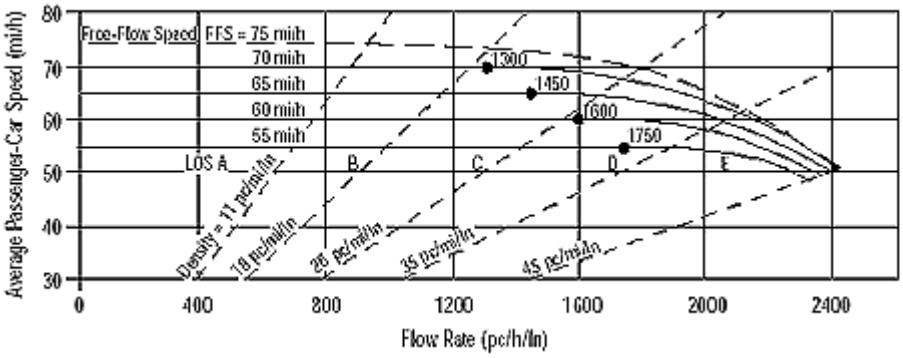
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *AM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SB I-15* |
| From/To | *north of Hwy 76* |
| Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6985* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2064* | pc/h/ln |
| S | *63.5* | mi/h |
| D = $v_p$ / S | *32.5* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
$v_p$ - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

$E_R$ - Exhibits23-8, 23-10
$E_T$ - Exhibits 23-8, 23-10, 23-11
$f_p$ - Page 23-12
LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3
$f_{LW}$ - Exhibit 23-4
$f_{LC}$ - Exhibit 23-5
$f_N$ - Exhibit 23-6
$f_{ID}$ - Exhibit 23-7

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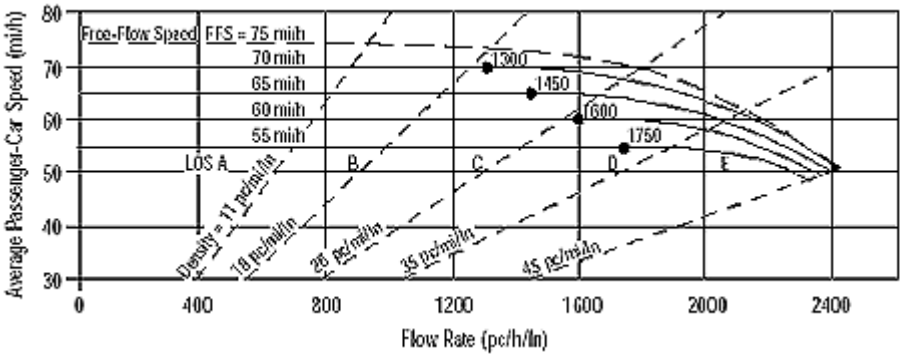
# BASIC FREEWAY SEGMENTS WORKSHEET




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | *W Hutcheson* |
| Agency or Company | *TPG Consulting* |
| Date Performed | *6/9/08* |
| Analysis Time Period | *PM* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SB I-15* |
| From/To | *north of Hwy 76* |
| Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Year | *2009 Operation* |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2573* | veh/h | Peak-Hour Factor, PHF | *0.88* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length | *mi* |
| Driver type adjustment | *1.00* | | Up/Down % | |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | *12.0* | ft |
| Rt-Shoulder Lat. Clearance | *6.0* | ft |
| Interchange Density | *0.50* | I/mi |
| Number of Lanes, N | *4* | |
| FFS (measured) | *70.0* | mi/h |
| Base free-flow Speed, BFFS | | mi/h |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mi/h |
| $f_{LC}$ | | mi/h |
| $f_{ID}$ | | mi/h |
| $f_N$ | | mi/h |
| FFS | *70.0* | mi/h |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *760* | pc/h/ln |
| S | *70.0* | mi/h |
| D = $v_p$ / S | *10.9* | pc/mi/ln |
| LOS | *A* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h |
| S | | mi/h |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
$v_p$ - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits23-8, 23-10 | $f_{LW}$ - Exhibit 23-4 |
| $E_T$ - Exhibits 23-8, 23-10, 23-11 | $f_{LC}$ - Exhibit 23-5 |
| $f_p$ - Page 23-12 | $f_N$ - Exhibit 23-6 |
| LOS, S, FFS, $v_p$ - Exhibits 23-2, 23-3 | $f_{ID}$ - Exhibit 23-7 |

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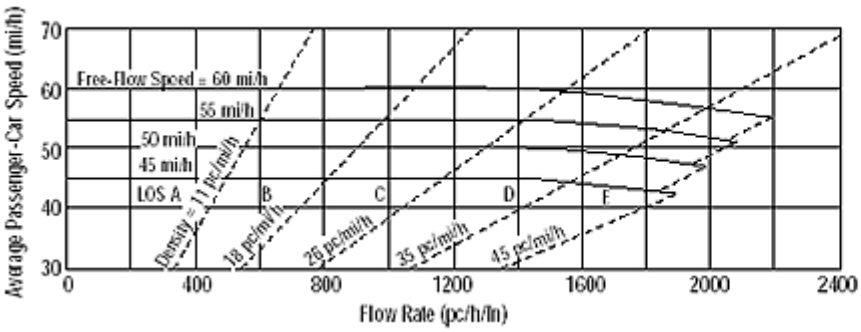
# MULTILANE HIGHWAYS WORKSHEET(Direction 2)




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | W Hutcheson |
| Agency or Company | TPG Consulting |
| Date Performed | 6/9/2008 |
| Analysis Time Period | AM |

## Site Information

| | |
|---|---|
| Highway/Direction to Travel | SR 76 |
| From/To | I-15 NB Ramps to Rice Canyon |
| Jurisdiction | Caltrans / San Diego Co |
| Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

## Flow Inputs

| | | | |
|---|---|---|---|
| Volume, V (veh/h) | 453 | Peak-Hour Factor, PHF | 0.88 |
| AADT(veh/h) | | %Trucks and Buses, $P_T$ | 25 |
| Peak-Hour Prop of AADT (veh/d) | | %RVs, $P_R$ | 2 |
| Peak-Hour Direction Prop, D | | General Terrain: | Level |
| DDHV (veh/h) | | Grade Length (mi) | 0.00 |
| Driver Type Adjustment | 1.00 | Up/Down % | 0.00 |
| | | Number of Lanes | 2 |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | 1.00 | $E_R$ | 1.2 |
| $E_T$ | 1.5 | $f_{HV}$ | 0.886 |

## Speed Inputs

| | |
|---|---|
| Lane Width, LW (ft) | 12.0 |
| Total Lateral Clearance, LC (ft) | 12.0 |
| Access Points, A (A/mi) | 0 |
| Median Type, M | |
| FFS (measured) | 60.0 |
| Base Free-Flow Speed, BFFS | |

## Calc Speed Adj and FFS

| | |
|---|---|
| $f_{LW}$ (mi/h) | |
| $f_{LC}$ (mi/h) | |
| $f_A$ (mi/h) | |
| $f_M$ (mi/h) | |
| FFS (mi/h) | 60.0 |

## Operations

Operational (LOS)

| | |
|---|---|
| Flow Rate, $v_p$ (pc/h/ln) | 290 |
| Speed, S (mi/h) | 60.0 |
| D (pc/mi/ln) | 4.8 |
| LOS | A |

## Design

Design (N)

| | |
|---|---|
| Required Number of Lanes, N | |
| Flow Rate, $v_p$ (pc/h) | |
| Max Service Flow Rate (pc/h/ln) | |
| Design LOS | |

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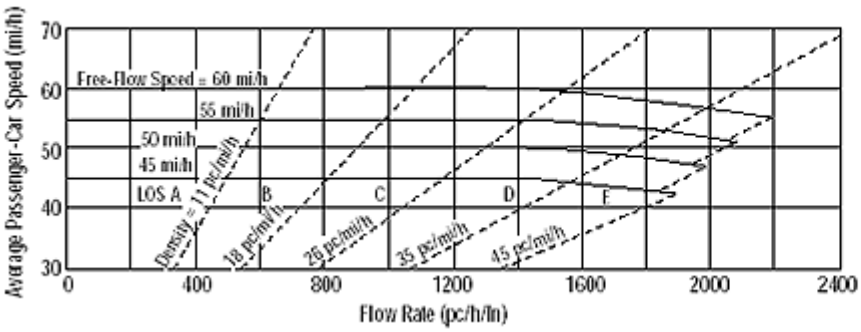
# MULTILANE HIGHWAYS WORKSHEET(Direction 2)




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | W Hutcheson |
| Agency or Company | TPG Consulting |
| Date Performed | 6/9/2008 |
| Analysis Time Period | PM |

## Site Information

| | |
|---|---|
| Highway/Direction to Travel | SR 76 |
| From/To | I-15 NB Ramps to Rice Canyon |
| Jurisdiction | Caltrans / San Diego Co |
| Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

## Flow Inputs

| | | | |
|---|---|---|---|
| Volume, V (veh/h) | 574 | Peak-Hour Factor, PHF | 0.88 |
| AADT(veh/h) | | %Trucks and Buses, $P_T$ | 6 |
| Peak-Hour Prop of AADT (veh/d) | | %RVs, $P_R$ | 2 |
| Peak-Hour Direction Prop, D | | General Terrain: | Level |
| DDHV (veh/h) | | Grade Length (mi) | 0.00 |
| Driver Type Adjustment | 1.00 | Up/Down % | 0.00 |
| | | Number of Lanes | 2 |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | 1.00 | $E_R$ | 1.2 |
| $E_T$ | 1.5 | $f_{HV}$ | 0.967 |

## Speed Inputs

| | |
|---|---|
| Lane Width, LW (ft) | 12.0 |
| Total Lateral Clearance, LC (ft) | 12.0 |
| Access Points, A (A/mi) | 0 |
| Median Type, M | |
| FFS (measured) | 60.0 |
| Base Free-Flow Speed, BFFS | |

## Calc Speed Adj and FFS

| | |
|---|---|
| $f_{LW}$ (mi/h) | |
| $f_{LC}$ (mi/h) | |
| $f_A$ (mi/h) | |
| $f_M$ (mi/h) | |
| FFS (mi/h) | 60.0 |

## Operations

Operational (LOS)

| | |
|---|---|
| Flow Rate, $v_p$ (pc/h/ln) | 337 |
| Speed, S (mi/h) | 60.0 |
| D (pc/mi/ln) | 5.6 |
| LOS | A |

## Design

Design (N)

| | |
|---|---|
| Required Number of Lanes, N | |
| Flow Rate, $v_p$ (pc/h) | |
| Max Service Flow Rate (pc/h/ln) | |
| Design LOS | |

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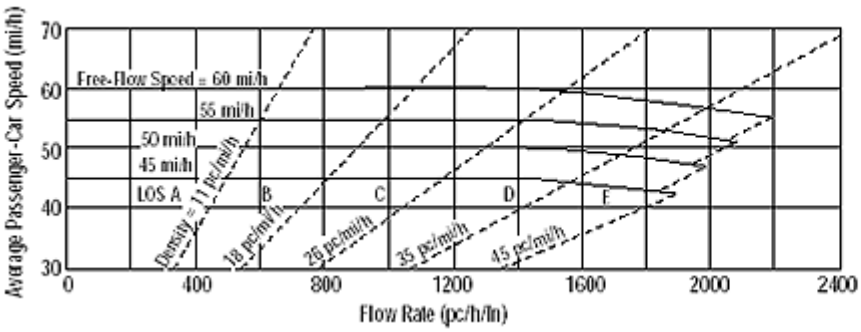
# MULTILANE HIGHWAYS WORKSHEET(Direction 1)




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | W Hutcheson |
| Agency or Company | TPG Consulting |
| Date Performed | 6/9/2008 |
| Analysis Time Period | AM |

## Site Information

| | |
|---|---|
| Highway/Direction to Travel | SR 76 |
| From/To | I-15 NB Ramps to Rice Canyon |
| Jurisdiction | Caltrans / San Diego Co |
| Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

## Flow Inputs

| | | | |
|---|---|---|---|
| Volume, V (veh/h) | 315 | Peak-Hour Factor, PHF | 0.88 |
| AADT(veh/h) | | %Trucks and Buses, $P_T$ | 25 |
| Peak-Hour Prop of AADT (veh/d) | | %RVs, $P_R$ | 2 |
| Peak-Hour Direction Prop, D | | General Terrain: | Level |
| DDHV (veh/h) | | Grade Length (mi) | 0.00 |
| Driver Type Adjustment | 1.00 | Up/Down % | 0.00 |
| | | Number of Lanes | 2 |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | 1.00 | $E_R$ | 1.2 |
| $E_T$ | 1.5 | $f_{HV}$ | 0.886 |

## Speed Inputs

| | |
|---|---|
| Lane Width, LW (ft) | 12.0 |
| Total Lateral Clearance, LC (ft) | 12.0 |
| Access Points, A (A/mi) | 0 |
| Median Type, M | |
| FFS (measured) | 60.0 |
| Base Free-Flow Speed, BFFS | |

## Calc Speed Adj and FFS

| | |
|---|---|
| $f_{LW}$ (mi/h) | |
| $f_{LC}$ (mi/h) | |
| $f_A$ (mi/h) | |
| $f_M$ (mi/h) | |
| FFS (mi/h) | 60.0 |

## Operations

Operational (LOS)

| | |
|---|---|
| Flow Rate, $v_p$ (pc/h/ln) | 202 |
| Speed, S (mi/h) | 60.0 |
| D (pc/mi/ln) | 3.4 |
| LOS | A |

## Design

Design (N)

| | |
|---|---|
| Required Number of Lanes, N | |
| Flow Rate, $v_p$ (pc/h) | |
| Max Service Flow Rate (pc/h/ln) | |
| Design LOS | |

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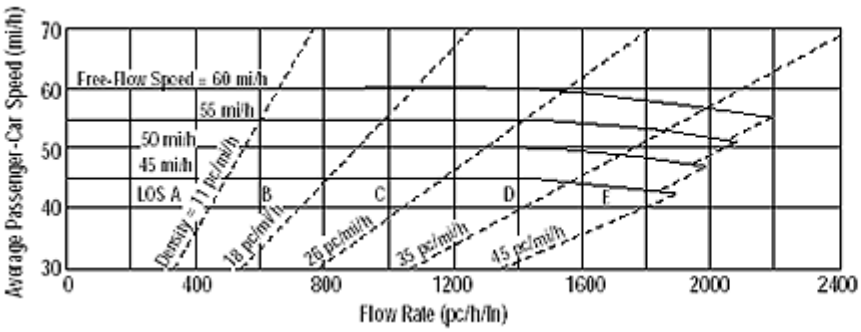
# MULTILANE HIGHWAYS WORKSHEET(Direction 1)




| Application | Input | Output |
|---|---|---|
| Operational (LOS) | FFS, N, $v_p$ | LOS, S, D |
| Design (N) | FFS, LOS, $v_p$ | N, S, D |
| Design ($v_p$) | FFS, LOS, N | $v_p$, S, D |
| Planning (LOS) | FFS, N, AADT | LOS, S, D |
| Planning (N) | FFS, LOS, AADT | N, S, D |
| Planning ($v_p$) | FFS, LOS, N | $v_p$, S, D |

## General Information

| | |
|---|---|
| Analyst | W Hutcheson |
| Agency or Company | TPG Consulting |
| Date Performed | 6/9/2008 |
| Analysis Time Period | PM |

## Site Information

| | |
|---|---|
| Highway/Direction to Travel | SR 76 |
| From/To | I-15 NB Ramps to Rice Canyon |
| Jurisdiction | Caltrans / San Diego Co |
| Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

## Flow Inputs

| | | | |
|---|---|---|---|
| Volume, V (veh/h) | 609 | Peak-Hour Factor, PHF | 0.88 |
| AADT(veh/h) | | %Trucks and Buses, $P_T$ | 4 |
| Peak-Hour Prop of AADT (veh/d) | | %RVs, $P_R$ | 2 |
| Peak-Hour Direction Prop, D | | General Terrain: | Level |
| DDHV (veh/h) | | Grade Length (mi) | 0.00 |
| Driver Type Adjustment | 1.00 | Up/Down % | 0.00 |
| | | Number of Lanes | 2 |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | 1.00 | $E_R$ | 1.2 |
| $E_T$ | 1.5 | $f_{HV}$ | 0.977 |

## Speed Inputs

| | |
|---|---|
| Lane Width, LW (ft) | 12.0 |
| Total Lateral Clearance, LC (ft) | 12.0 |
| Access Points, A (A/mi) | 0 |
| Median Type, M | |
| FFS (measured) | 60.0 |
| Base Free-Flow Speed, BFFS | |

## Calc Speed Adj and FFS

| | |
|---|---|
| $f_{LW}$ (mi/h) | |
| $f_{LC}$ (mi/h) | |
| $f_A$ (mi/h) | |
| $f_M$ (mi/h) | |
| FFS (mi/h) | 60.0 |

## Operations

Operational (LOS)

| | |
|---|---|
| Flow Rate, $v_p$ (pc/h/ln) | 354 |
| Speed, S (mi/h) | 60.0 |
| D (pc/mi/ln) | 5.9 |
| LOS | A |

## Design

Design (N)

| | |
|---|---|
| Required Number of Lanes, N | |
| Flow Rate, $v_p$ (pc/h) | |
| Max Service Flow Rate (pc/h/ln) | |
| Design LOS | |

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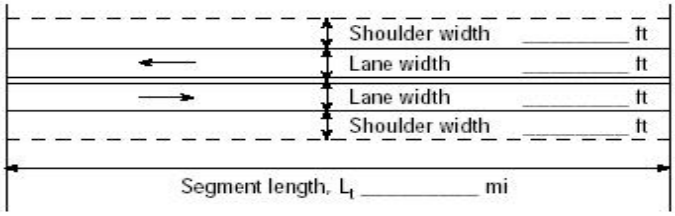
# TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *W Hutcheson* | Highway | *Highway 76* |
| Agency or Company | *TPG Consulting* | From/To | *west of Old Highway 395* |
| Date Performed | *6/9/08* | Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Time Period | *AM* | Analysis Year | *2009 Operation* |

Project Description: *07-1087 Pala Power Plant*

***Input Data***



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

| | |
|---|---|
| Two-way hourly volume | *1567* veh/h |
| Directional split | *53 / 47* |
| Peak-hour factor, PHF | *0.88* |
| No-passing zone | *100* |
| % Trucks and Buses , $P_T$ | *13* % |
| % Recreational vehicles, $P_R$ | *0%* |
| Access points/ *mi* | *8* |

***Average Travel Speed***

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-7) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *0.987* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *1804* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *956* |

| Free-Flow Speed from Field Measurement | | Estimated Free-Flow Speed | |
|---|---|---|---|
| Field Measured speed, $S_{FM}$ | *55 mi/h* | Base free-flow speed, $BFFS_{FM}$ | *mi/h* |
| Observed volume, $V_f$ | *0 veh/h* | Adj. for lane width and shoulder width[3], $f_{LS}$ (Exhibit 20-5) | *mi/h* |
| Free-flow speed, FFS FFS=$S_{FM}$+0.00776($V_f$/ $f_{HV}$ ) | *mi/h* | Adj. for access points, $f_A$ (Exhibit 20-6) | *mi/h* |
| | | Free-flow speed, FFS (FSS=BFFS-$f_{LS}$-$f_A$) | *55.0 mi/h* |

| | |
|---|---|
| Adj. for no-passing zones, $f_{np}$ ( *mi/h*) (Exhibit 20-11) | *1.3* |
| Average travel speed, ATS ( *mi/h*) ATS=FFS-0.00776$v_p$-$f_{np}$ | *39.7* |

***Percent Time-Spent-Following***

| | |
|---|---|
| Grade Adjustment factor, $f_G$ (Exhibit 20-8) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10) | *1.0* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *1.000* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *1781* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *944* |
| Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$) | *79.1* |
| Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12) | *5.7* |
| Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$ | *84.8* |

***Level of Service and Other Performance Measures***

| | |
|---|---|
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) | *E* |
| Volume to capacity ratio, v/c=$V_p$/ 3,200 | *0.56* |
| Peak 15-min veh-miles of travel, $VMT_{15}$ (veh- *mi*)= 0.25$L_t$(V/PHF) | *445* |
| Peak-hour vehicle-miles of travel, $VMT_{60}$(veh- *mi*)=V*$L_t$ | *1567* |
| Peak 15-min total travel time, $TT_{15}$(veh-h)= $VMT_{15}$/ATS | *11.2* |

***Notes***

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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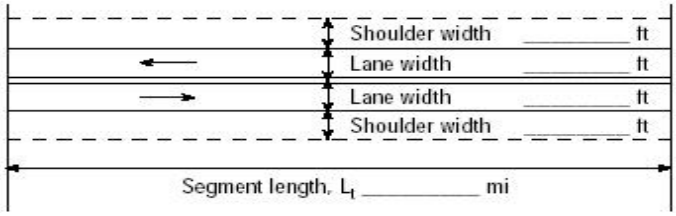
# TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *W Hutcheson* | Highway | *Highway 76* |
| Agency or Company | *TPG Consulting* | From/To | *west of Old Highway 395* |
| Date Performed | *6/9/08* | Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Time Period | *PM* | Analysis Year | *2009 Operation* |

Project Description: *07-1087 Pala Power Plant*

**Input Data**



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

| | |
|---|---|
| Two-way hourly volume | *2178* veh/h |
| Directional split | *54 / 46* |
| Peak-hour factor, PHF | *0.88* |
| No-passing zone | *100* |
| % Trucks and Buses , $P_T$ | *10* % |
| % Recreational vehicles, $P_R$ | *0%* |
| Access points/ *mi* | *8* |

**Average Travel Speed**

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-7) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}$=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$ ) | *0.990* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *2500* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *1350* |

| Free-Flow Speed from Field Measurement | | Estimated Free-Flow Speed | |
|---|---|---|---|
| Field Measured speed, $S_{FM}$ | *55 mi/h* | Base free-flow speed, $BFFS_{FM}$ | *mi/h* |
| Observed volume, $V_f$ | *0 veh/h* | Adj. for lane width and shoulder width[3], $f_{LS}$ (Exhibit 20-5) | *mi/h* |
| Free-flow speed, FFS FFS=$S_{FM}$+0.00776($V_f$/ $f_{HV}$ ) | *mi/h* | Adj. for access points, $f_A$ (Exhibit 20-6) | *mi/h* |
| | | Free-flow speed, FFS (FSS=BFFS-$f_{LS}$-$f_A$) | *55.0 mi/h* |

| | |
|---|---|
| Adj. for no-passing zones, $f_{np}$ ( *mi/h*) (Exhibit 20-11) | *1.0* |
| Average travel speed, ATS ( *mi/h*) ATS=FFS-0.00776$v_p$-$f_{np}$ | *34.5* |

**Percent Time-Spent-Following**

| | |
|---|---|
| Grade Adjustment factor, $f_G$ (Exhibit 20-8) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10) | *1.0* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}$=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$ ) | *1.000* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *2475* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *1337* |
| Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$) | *88.6* |
| Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12) | *2.7* |
| Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$ | *91.4* |

**Level of Service and Other Performance Measures**

| | |
|---|---|
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) | *E* |
| Volume to capacity ratio, v/c=$V_p$/ 3,200 | *0.78* |
| Peak 15-min veh-miles of travel, $VMT_{15}$ (veh- *mi*)= 0.25$L_t$(V/PHF) | *124* |
| Peak-hour vehicle-miles of travel, $VMT_{60}$(veh- *mi*)=V*$L_t$ | *436* |
| Peak 15-min total travel time, $TT_{15}$(veh-h)= $VMT_{15}$/ATS | *3.6* |

**Notes**

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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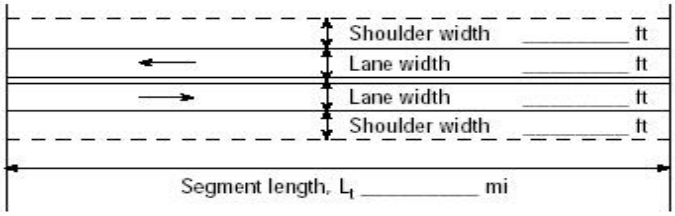
# TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *W Hutcheson* | Highway | *Highway 76* |
| Agency or Company | *TPG Consulting* | From/To | *Rice Canyon to Project* |
| Date Performed | *6/9/08* | Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Time Period | *AM* | Analysis Year | *2009 Operation* |

Project Description: *07-1087 Pala Power Plant*

**Input Data**



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

| | |
|---|---|
| Two-way hourly volume | *657* veh/h |
| Directional split | *63 / 37* |
| Peak-hour factor, PHF | *0.88* |
| No-passing zone | *75* |
| % Trucks and Buses , $P_T$ | *9 %* |
| % Recreational vehicles, $P_R$ | *0%* |
| Access points/ *mi* | *2* |

**Average Travel Speed**

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-7) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *0.991* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *753* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *474* |

| Free-Flow Speed from Field Measurement | | Estimated Free-Flow Speed | |
|---|---|---|---|
| Field Measured speed, $S_{FM}$ | *55 mi/h* | Base free-flow speed, $BFFS_{FM}$ | *mi/h* |
| Observed volume, $V_f$ | *0 veh/h* | Adj. for lane width and shoulder width[3], $f_{LS}$ (Exhibit 20-5) | *mi/h* |
| Free-flow speed, FFS FFS=$S_{FM}$+0.00776($V_f$/ $f_{HV}$ ) | *mi/h* | Adj. for access points, $f_A$ (Exhibit 20-6) | *mi/h* |
| | | Free-flow speed, FFS (FSS=BFFS-$f_{LS}$-$f_A$) | *55.0 mi/h* |

| | |
|---|---|
| Adj. for no-passing zones, $f_{np}$ ( *mi/h*) (Exhibit 20-11) | *2.8* |
| Average travel speed, ATS ( *mi/h*) ATS=FFS-0.00776$v_p$-$f_{np}$ | *46.4* |

**Percent Time-Spent-Following**

| | |
|---|---|
| Grade Adjustment factor, $f_G$ (Exhibit 20-8) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *0.991* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *753* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *474* |
| Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$) | *48.4* |
| Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12) | *15.0* |
| Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$ | *63.4* |

**Level of Service and Other Performance Measures**

| | |
|---|---|
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) | *C* |
| Volume to capacity ratio, v/c=$V_p$/ 3,200 | *0.24* |
| Peak 15-min veh-miles of travel, $VMT_{15}$ (veh- *mi*)= 0.25$L_t$(V/PHF) | *373* |
| Peak-hour vehicle-miles of travel, $VMT_{60}$(veh- *mi*)=V*$L_t$ | *1314* |
| Peak 15-min total travel time, $TT_{15}$(veh-h)= $VMT_{15}$/ATS | *8.0* |

**Notes**

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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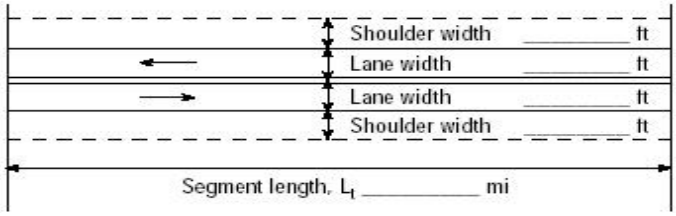
# TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *W Hutcheson* | Highway | *Highway 76* |
| Agency or Company | *TPG Consulting* | From/To | *Rice Canyon to Project* |
| Date Performed | *6/9/08* | Jurisdiction | *Caltrans/San Diego Co* |
| Analysis Time Period | *PM* | Analysis Year | *2009 Operation* |

Project Description: *07-1087 Pala Power Plant*

**Input Data**



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

| | |
|---|---|
| Two-way hourly volume | *869* veh/h |
| Directional split | *59 / 41* |
| Peak-hour factor, PHF | *0.88* |
| No-passing zone | *75* |
| % Trucks and Buses , $P_T$ | *5* % |
| % Recreational vehicles, $P_R$ | *0%* |
| Access points/ *mi* | *2* |

**Average Travel Speed**

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-7) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *0.995* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *992* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *585* |

| Free-Flow Speed from Field Measurement | | Estimated Free-Flow Speed | |
|---|---|---|---|
| Field Measured speed, $S_{FM}$ | *55 mi/h* | Base free-flow speed, $BFFS_{FM}$ | *mi/h* |
| Observed volume, $V_f$ | *0 veh/h* | Adj. for lane width and shoulder width[3], $f_{LS}$ (Exhibit 20-5) | *mi/h* |
| Free-flow speed, FFS FFS=$S_{FM}$+0.00776($V_f$/ $f_{HV}$ ) | *mi/h* | Adj. for access points, $f_A$ (Exhibit 20-6) | *mi/h* |
| | | Free-flow speed, FFS (FSS=BFFS-$f_{LS}$-$f_A$) | *55.0 mi/h* |

| | |
|---|---|
| Adj. for no-passing zones, $f_{np}$ ( *mi/h*) (Exhibit 20-11) | *2.2* |
| Average travel speed, ATS ( *mi/h*) ATS=FFS-0.00776$v_p$-$f_{np}$ | *45.1* |

**Percent Time-Spent-Following**

| | |
|---|---|
| Grade Adjustment factor, $f_G$ (Exhibit 20-8) | *1.00* |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10) | *1.1* |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10) | *1.0* |
| Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ | *0.995* |
| Two-way flow rate[1], $v_p$ (pc/h)=V/ (PHF * $f_G$ * $f_{HV}$) | *992* |
| $v_p$ * highest directional split proportion[2] (pc/h) | *585* |
| Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$) | *58.2* |
| Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12) | *11.6* |
| Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$ | *69.8* |

**Level of Service and Other Performance Measures**

| | |
|---|---|
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) | *D* |
| Volume to capacity ratio, v/c=$V_p$/ 3,200 | *0.31* |
| Peak 15-min veh-miles of travel, $VMT_{15}$ (veh- *mi*)= 0.25$L_t$(V/PHF) | *494* |
| Peak-hour vehicle-miles of travel, $VMT_{60}$(veh- *mi*)=V*$L_t$ | *1738* |
| Peak 15-min total travel time, $TT_{15}$(veh-h)= $VMT_{15}$/ATS | *10.9* |

**Notes**

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | NB I-15 |
| Agency or Company | TPG Consulting | Junction | NB Off-Ramp |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans/San Diego Co |
| Analysis Time Period | AM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{up}$ = ft

$V_u$ = veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

$L_{down}$ = 3300 ft

$V_D$ = 578 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 1417 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 1675 |
| Ramp | 400 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 473 |
| UpStream | | | | | | | | |
| DownStream | 578 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 690 |

## Estimation of $v_{12}$ — Merge Areas

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = using Equation (Exhibit 25-5)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-8)

## Estimation of $v_{12}$ — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = 0.436 using Equation (Exhibit 25-12)

$V_{12}$ = 997 pc/h

$V_3$ or $V_{av34}$ 339 pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 25-7 | | |

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 1675 | Exhibit 25-14 | 9600 | No |
| $V_{FO} = V_F - V_R$ | 1202 | Exhibit 25-14 | 9600 | No |
| $V_R$ | 473 | Exhibit 25-3 | 2000 | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 25-7 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 997 | Exhibit 25-14 | 4400:All | No |

## Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = 10.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

## Speed Determination

$M_S$ = (Exibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

## Speed Determination

$D_s$ = 0.471 (Exhibit 25-19)

$S_R$= 56.8 mph (Exhibit 25-19)

$S_0$= 76.8 mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | NB I-15 |
| Agency or Company | TPG Consulting | Junction | NB Off-Ramp |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans/San Diego Co |
| Analysis Time Period | PM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{up}$ = ft

$V_u$ = veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

$L_{down}$ = 3300 ft

$V_D$ = 782 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 7094 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 8384 |
| Ramp | 812 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 960 |
| UpStream | | | | | | | | |
| DownStream | 782 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 933 |

## Estimation of $v_{12}$ — Merge Areas

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = using Equation (Exhibit 25-5)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-8)

## Estimation of $v_{12}$ — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = 0.436 using Equation (Exhibit 25-12)

$V_{12}$ = 4197 pc/h

$V_3$ or $V_{av34}$ 2093 pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 25-7 | | |

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 8384 | Exhibit 25-14 | 9600 | No |
| $V_{FO} = V_F - V_R$ | 7424 | Exhibit 25-14 | 9600 | No |
| $V_R$ | 960 | Exhibit 25-3 | 2000 | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 25-7 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 4197 | Exhibit 25-14 | 4400:All | No |

## Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = 38.1 (pc/mi/ln)

LOS = E (Exhibit 25-4)

## Speed Determination

$M_S$ = (Exibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

## Speed Determination

$D_s$ = 0.514 (Exhibit 25-19)

$S_R$= 55.6 mph (Exhibit 25-19)

$S_0$= 72.5 mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | NB I-15 |
| Agency or Company | TPG Consulting | Junction | NB on-ramp from Hwy 76 |
| Date Performed | 4/4/2007 | Jurisdiction | Caltrans |
| Analysis Time Period | AM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

$L_{up}$ = 3300 ft

$V_u$ = 400 veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{down}$ = ft

$V_D$ = veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | $v = V/PHF \times f_{HV} \times f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 1018 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 1215 |
| Ramp | 578 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 690 |
| UpStream | 400 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 473 |
| DownStream | | | | | | | | |

## Estimation of $v_{12}$ — Merge Areas

$$V_{12} = V_F ( P_{FM} )$$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = 0.355 using Equation (Exhibit 25-5)

$V_{12}$ = 431 pc/h

$V_3$ or $V_{av34}$ 392 pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 486 pc/h (Equation 25-8)

## Estimation of $v_{12}$ — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = using Equation (Exhibit 25-12)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 1905 | Exhibit 25-7 | | No |

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 25-14 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 25-14 | | |
| $V_R$ | | Exhibit 25-3 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 1176 | Exhibit 25-7 | 4600:All | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 25-14 | | |

## Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

$D_R$ = 9.9 (pc/mi/ln)

LOS = A (Exhibit 25-4)

## Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Speed Determination

$M_S$ = 0.285 (Exibit 25-19)

$S_R$= 62.0 mph (Exhibit 25-19)

$S_0$= 70.0 mph (Exhibit 25-19)

## Speed Determination

$D_s$ = (Exhibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | NB I-15 |
| Agency or Company | TPG Consulting | Junction | NB on-ramp from Hwy 76 |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans |
| Analysis Time Period | PM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

$L_{up}$ = 3300 ft

$V_u$ = 812 veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{down}$ = ft

$V_D$ = veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | $v = V/PHF \times f_{HV} \times f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 6281 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 7494 |
| Ramp | 782 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 933 |
| UpStream | 812 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 960 |
| DownStream | | | | | | | | |

Merge Areas

## Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = 0.324 using Equation (Exhibit 25-5)

$V_{12}$ = 2429 pc/h

$V_3$ or $V_{av34}$ 2532 pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, $V_{12a}$ = 2997 pc/h (Equation 25-8)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 8427 | Exhibit 25-7 | | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 3930 | Exhibit 25-7 | 4600:All | No |

## Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = 31.3 (pc/mi/ln)

LOS = D (Exhibit 25-4)

## Speed Determination

$M_S$ = 0.471 (Exibit 25-19)

$S_R$= 56.8 mph (Exhibit 25-19)

$S_0$= 63.7 mph (Exhibit 25-19)

Diverge Areas

## Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = using Equation (Exhibit 25-12)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 25-14 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 25-14 | | |
| $V_R$ | | Exhibit 25-3 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 25-14 | | |

## Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Speed Determination

$D_s$ = (Exhibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | SB I-15 |
| Agency or Company | TPG Consulting | Junction | SB Off-Ramp |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans/San Diego Co |
| Analysis Time Period | AM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{up}$ = ft

$V_u$ = veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

$L_{down}$ = 3500 ft

$V_D$ = 491 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 6985 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 8334 |
| Ramp | 754 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 900 |
| UpStream | | | | | | | | |
| DownStream | 491 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 580 |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = using Equation (Exhibit 25-5)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-8)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 25-7 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 25-7 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

### Speed Determination

$M_S$ = (Exibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = 0.436 using Equation (Exhibit 25-12)

$V_{12}$ = 4141 pc/h

$V_3$ or $V_{av34}$ 2096 pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 8334 | Exhibit 25-14 | 9600 | No |
| $V_{FO} = V_F - V_R$ | 7434 | Exhibit 25-14 | 9600 | No |
| $V_R$ | 900 | Exhibit 25-3 | 2000 | No |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 4141 | Exhibit 25-14 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = 38.7 (pc/mi/ln)

LOS = E (Exhibit 25-4)

### Speed Determination

$D_s$ = 0.509 (Exhibit 25-19)

$S_R$= 55.7 mph (Exhibit 25-19)

$S_0$= 72.5 mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | SB I-15 |
| Agency or Company | TPG Consulting | Junction | SB Off-Ramp |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans/San Diego Co |
| Analysis Time Period | PM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{up}$ = ft

$V_u$ = veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

$L_{down}$ = 3500 ft

$V_D$ = 449 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 2573 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 3070 |
| Ramp | 824 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 983 |
| UpStream | | | | | | | | |
| DownStream | 449 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 531 |

## Estimation of $v_{12}$ — Merge Areas

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = using Equation (Exhibit 25-5)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-8)

## Estimation of $v_{12}$ — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = 0.436 using Equation (Exhibit 25-12)

$V_{12}$ = 1893 pc/h

$V_3$ or $V_{av34}$ 588 pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 25-7 | | |

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 3070 | Exhibit 25-14 | 9600 | No |
| $V_{FO} = V_F - V_R$ | 2087 | Exhibit 25-14 | 9600 | No |
| $V_R$ | 983 | Exhibit 25-3 | 2000 | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 25-7 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 1893 | Exhibit 25-14 | 4400:All | No |

## Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = 19.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

## Speed Determination

$M_S$ = (Exibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

## Speed Determination

$D_s$ = 0.516 (Exhibit 25-19)

$S_R$= 55.5 mph (Exhibit 25-19)

$S_0$= 76.8 mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | SB I-15 |
| Agency or Company | TPG Consulting | Junction | SB on-ramp from Hwy 76 |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans |
| Analysis Time Period | AM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

$L_{up}$ = 3500 ft

$V_u$ = 754 veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{down}$ = ft

$V_D$ = veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 6231 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 7364 |
| Ramp | 491 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 580 |
| UpStream | 754 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 900 |
| DownStream | | | | | | | | |

Merge Areas | Diverge Areas

## Estimation of $v_{12}$ (Merge Areas)

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = 0.344 using Equation (Exhibit 25-5)

$V_{12}$ = 2536 pc/h

$V_3$ or $V_{av34}$ 2414 pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 2945 pc/h (Equation 25-8)

## Estimation of $v_{12}$ (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = using Equation (Exhibit 25-12)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks (Merge Areas)

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 7944 | Exhibit 25-7 | | No |

## Capacity Checks (Diverge Areas)

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 25-14 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 25-14 | | |
| $V_R$ | | Exhibit 25-3 | | |

## Flow Entering Merge Influence Area (Merge Areas)

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 3525 | Exhibit 25-7 | 4600:All | No |

## Flow Entering Merge Influence Area (Diverge Areas)

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 25-14 | | |

## Level of Service Determination (if not F) (Merge Areas)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

$D_R$ = 28.8 (pc/mi/ln)

LOS = D (Exhibit 25-4)

## Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Speed Determination (Merge Areas)

$M_S$ = 0.410 (Exibit 25-19)

$S_R$= 58.5 mph (Exhibit 25-19)

$S_0$= 63.8 mph (Exhibit 25-19)

## Speed Determination (Diverge Areas)

$D_s$ = (Exhibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | W Hutcheson | Freeway/Dir of Travel | SB I-15 |
| Agency or Company | TPG Consulting | Junction | SB on-ramp from Hwy 76 |
| Date Performed | 6/9/08 | Jurisdiction | Caltrans |
| Analysis Time Period | PM | Analysis Year | 2009 Operation |

Project Description 07-1087 Pala Power Plant

## Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

$L_{up}$ = 3500 ft

$V_u$ = 824 veh/h

Terrain: Level

$S_{FF}$ = 70.0 mph $S_{FR}$ = 35.0 mph

Sketch ( show lanes, $L_A$, $L_D$, $V_R$, $V_f$)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

$L_{down}$ = ft

$V_D$ = veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | $v = V/PHF \times f_{HV} \times f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 1749 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 2067 |
| Ramp | 449 | 0.88 | Level | 8 | 0 | 0.962 | 1.00 | 531 |
| UpStream | 824 | 0.88 | Level | 10 | 0 | 0.952 | 1.00 | 983 |
| DownStream | | | | | | | | |

## Estimation of $v_{12}$ — Merge Areas

$$V_{12} = V_F ( P_{FM} )$$

$L_{EQ}$ = (Equation 25-2 or 25-3)

$P_{FM}$ = 0.351 using Equation (Exhibit 25-5)

$V_{12}$ = 725 pc/h

$V_3$ or $V_{av34}$ 671 pc/h (Equation 25-4 or 25-5)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 826 pc/h (Equation 25-8)

## Estimation of $v_{12}$ — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

$L_{EQ}$ = (Equation 25-8 or 25-9)

$P_{FD}$ = using Equation (Exhibit 25-12)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 25-15 or 25-16)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 25-18)

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 2598 | Exhibit 25-7 | | No |

## Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 25-14 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 25-14 | | |
| $V_R$ | | Exhibit 25-3 | | |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 1357 | Exhibit 25-7 | 4600:All | No |

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 25-14 | | |

## Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

$D_R$ = 11.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

## Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 25-4)

## Speed Determination

$M_S$ = 0.292 (Exibit 25-19)

$S_R$= 61.8 mph (Exhibit 25-19)

$S_0$= 69.6 mph (Exhibit 25-19)

## Speed Determination

$D_s$ = (Exhibit 25-19)

$S_R$= mph (Exhibit 25-19)

$S_0$= mph (Exhibit 25-19)