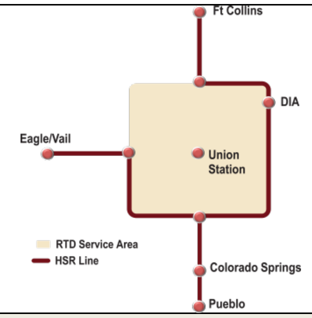
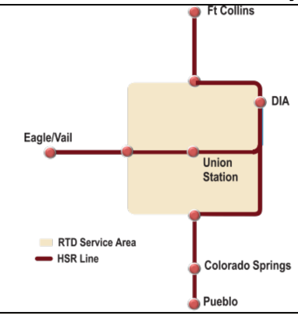
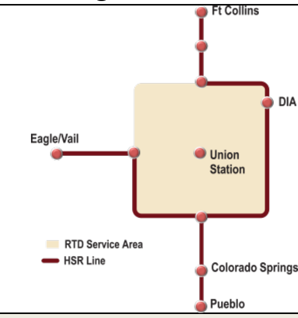
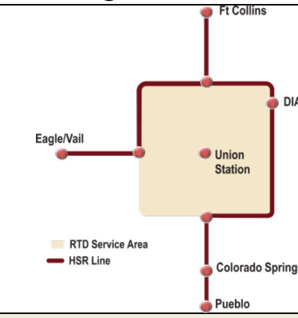
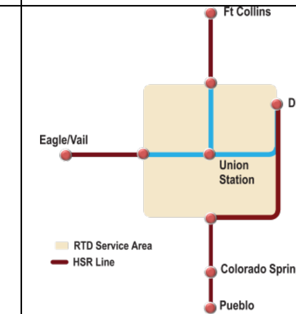
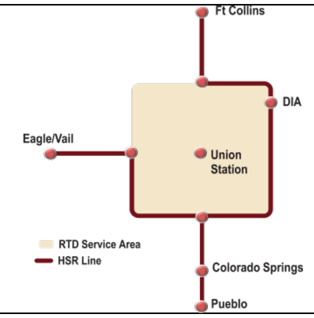
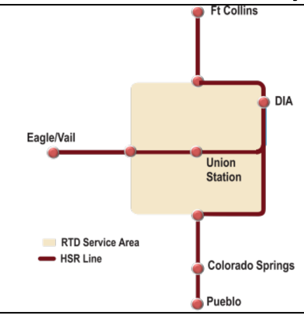
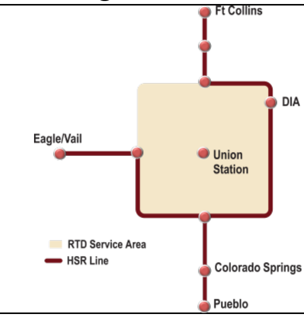
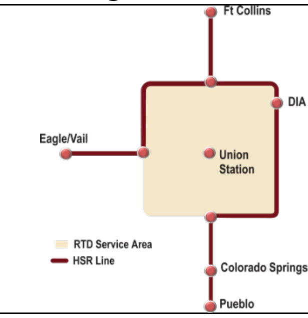
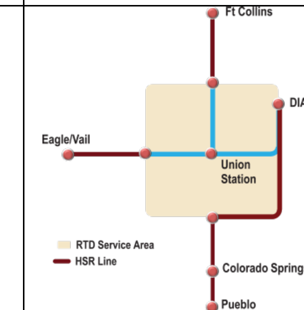
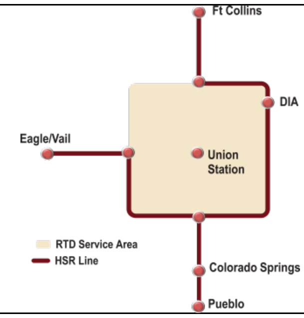
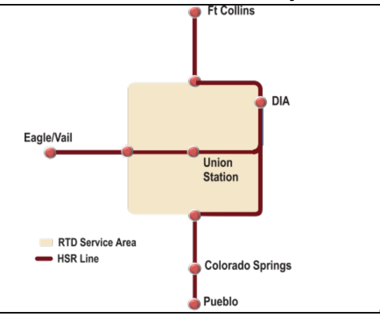
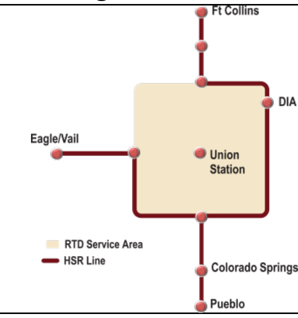
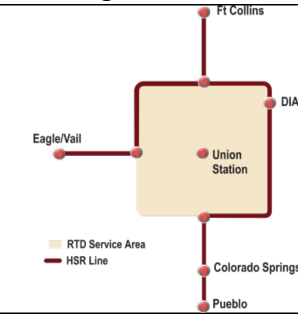
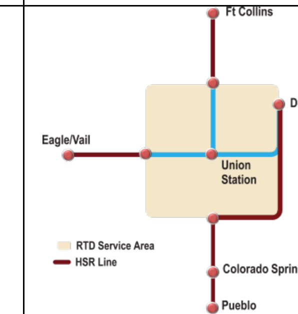
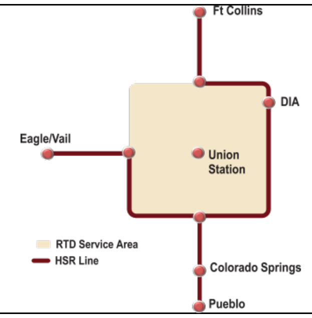
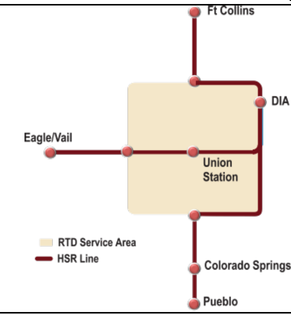
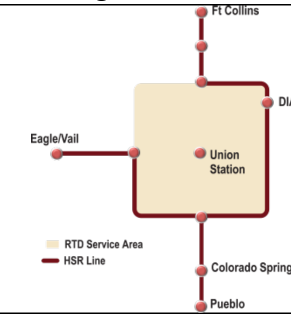
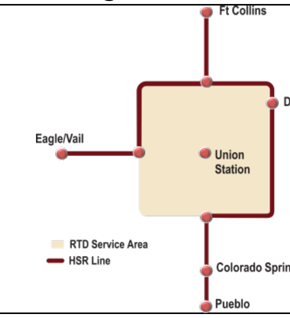
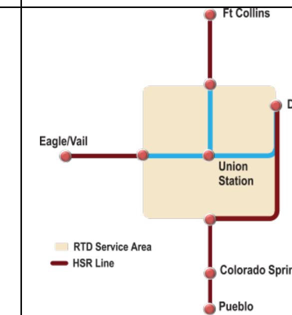
Appendix A:

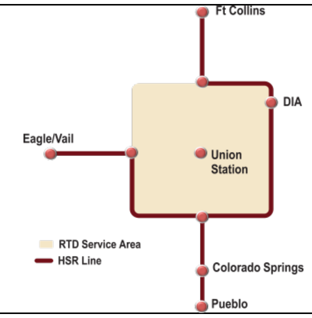
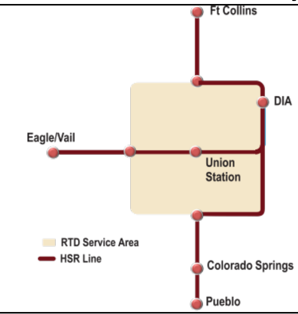
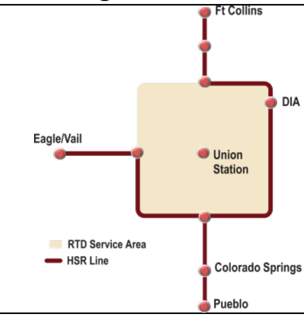
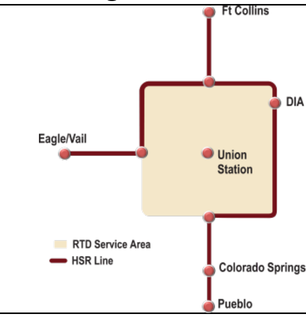
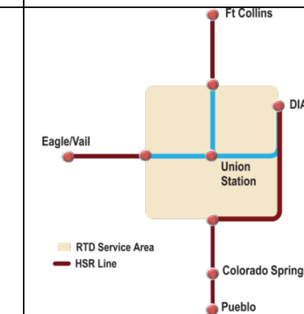
Level 2 Scenario Evaluation Summary

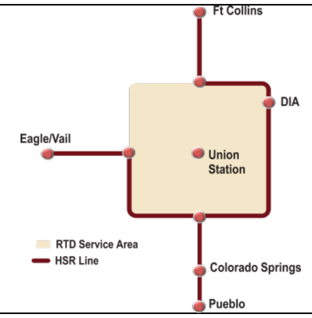
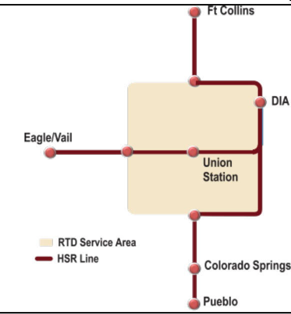
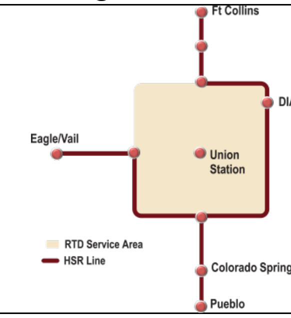
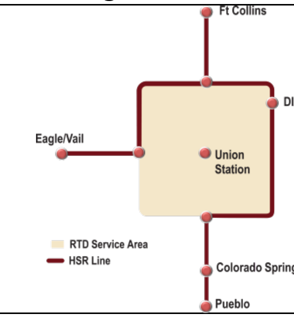
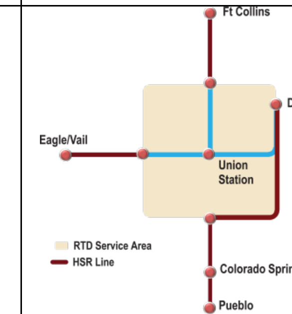
Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
Description NOTE: The descriptions provided here are for orientation purposes and are not meant to describe the alignments (or conflicts) in detail. When describing the alignments, transportation corridors are mentioned for orientation purposes but in most cases, the alignments are not wholly within public ROW. Detailed drawings of the alignments are contained as a separate document that accompanies the Level 2 Evaluation report.		This alternative travels W-E from I-70/C-470 along I-76 (Option A) or US 6 (Option B) to central Denver (DUS or Stockyard Station) and along the freight railroad CML/Brush Line to 96th Avenue to Pena Boulevard, continuing to DIA. N-S through Denver, this alternative generally travels the freight railroad to DUS and continues on the freight railroad Joint Line/Santa Fe Drive corridors to C-470. North of the Denver metropolitan area, the alignment generally follows either the I-25 alignment to Fort Collins or just east of the I-25 alignment along US 287. South of the Denver metropolitan area, the alignment generally follows the I-25 corridor.	This alternative travels W-E through Denver along the same options described for alternative A-1 (either I-76 or US 6). N-S, the alignment follows E-470 to DIA, continuing south along E-470 to I-25. North and south of the Denver metropolitan area, the alignment options are the same as described for A-1.	This alternative provides HSIPR around the Denver metropolitan area using a beltway along the existing C-470 and E-470 corridors. No connection would be provided in the NW quadrant. North and south of the Denver metropolitan area, the alignment options are the same as described for A-1.	This alternative is similar to B-2, except that no beltway connection would be provided in the SW quadrant.	This alternative assumes that HSIPR will use an operating window on the existing East Rail and Gold Line Commuter Rail projects and the future North Metro Commuter Rail project. FRA compliant technology would be required. A new HSIPR connection would be provided in the southeast quadrant of the metro area from I-25 at Lone Tree, continuing along E470 to DIA.
Public Benefits						
Fulfillment of Purpose and Need	• Yes/No	**Not a discriminator** - All of the Level 2 Evaluation scenarios fulfill the P&N statement as all produce positive operating ratios and all have a positive Benefit/Cost ratio. Details below: A-1A = Operating ratio of 1.32 and B/C of 1.98 A-1B = Operating ratio of 1.45 and B/C of 2.03	**Not a discriminator** - All of the Level 2 Evaluation scenarios fulfill the P&N statement as all produce positive operating ratios and all have a positive Benefit/Cost ratio. Details below: A-5A = Operating ratio of 1.32 and B/C of 2.0 A-5B = Operating ratio of 1.35 and B/C of 2.03	**Not a discriminator** - All of the Level 2 Evaluation scenarios fulfill the P&N statement as all produce positive operating ratios and all have a positive Benefit/Cost ratio. Details below: B-2A = Operating ratio of 1.21 and B/C of 2.01	**Not a discriminator** - All of the Level 2 Evaluation scenarios fulfill the P&N statement as all produce positive operating ratios and all have a positive Benefit/Cost ratio. Details below: B-5 = Operating ratio of 1.19 and B/C of 1.99	**Not a discriminator** - All of the Level 2 Evaluation scenarios fulfill the P&N statement as all produce positive operating ratios and all have a positive Benefit/Cost ratio. Details below: C-1 = Operating ratio of 1.05 and B/C of 1.97
Governance and stakeholder support						

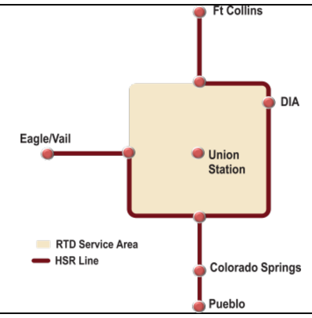
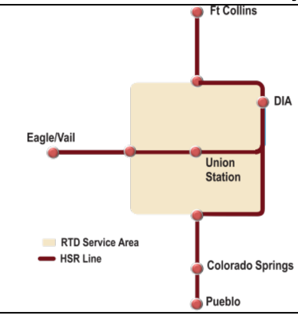
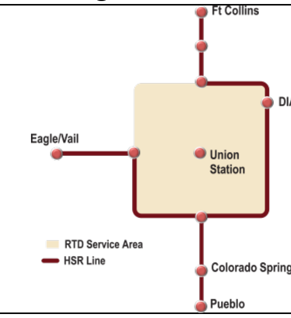
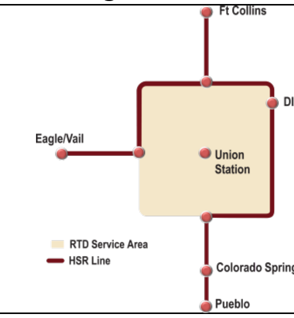
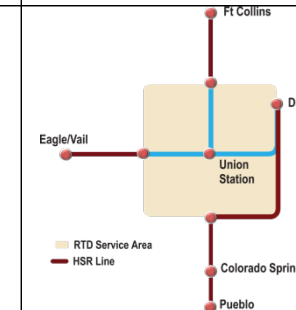
Criterion		Scenario A-1: Direct Routing through Denver  	Scenario A-5: Through Denver with Eastern Beltway  	Scenario B-2A: Denver Periphery Excluding the NW Quadrant  	Scenario B-5: Denver Periphery Excluding the SW Quadrant  	Scenario C-1: Shared Track 
• Public support	• Summary of public comments •	**The public in each portion of the study area, with the exception of the Denver area, expressed a general preference for the scenario that offered them the most options in service.** **Fort Collins –** Stakeholders in this portion of the study area are most concerned that the commuter rail option on SH 287 be retained if HSR is built in the I-25 ROW. Some residents favored the direct access provided by A-1 to DUS and felt that getting into Denver would have higher support than getting to the airport. **Denver**- There was no clear direction given at the public meeting at Denver. Similar to the PLT, some want access at DUS and others recognize the impacts associated with construction of A-1 and A-5 through the metro area. **Colorado Springs –** Public meeting participants were more focused on the dismissal of the alignment through the Black Forest than they were on expressing a strong preference for other scenarios. Some support was expressed for the A-1 routing as it provides direct access to downtown Denver for work and recreational activities. There appeared to be a preference for getting to downtown Denver over getting to DIA on a regular basis. One key concern is that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group. **Pueblo –** No real preference was stated by the group, however, there was support expressed for the A-1 routing as it provides a link between Pueblo and downtown Denver destinations. **Mountains –** The Mountain stakeholders expressed support for Scenarios A-1 and A-5 as they provide a direct link from the mountain corridor through DUS to DIA. One –seat ride and direct, convenient service between DIA and the mountain corridor is preferred.	**The public in each portion of the study area, with the exception of the Denver area, expressed a general preference for scenarios that offered them the most options in service.** **Fort Collins –** Stakeholders in this portion of the study area are most concerned that the commuter rail option on SH 287 be retained if HSR is built in the I-25 ROW. Although some residents favored the direct access provided by A-1 to DUS, others recognized that A-5 linked the northern cities with DIA and Colorado Springs and Pueblo in a way that avoided the impacts and slower speeds through the Denver area. **Denver**- There was no clear direction given at the public meeting at Denver. Similar to the PLT so want access at DUS and others recognize the impacts associated with construction of A-1 and A-5 through the metro area. **Colorado Springs –** Public meeting participants were more focused on the dismissal of the alignment through the Black Forest than they were on expressing a strong preference for other scenarios. Scenario A-5 was viewed as providing easy access to DIA and northern cities without the delay of getting through Denver either on the RTD system or slower HSR, although support for A-5 was not as strong as support for B2-A. One key concern is that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group. **Pueblo –** No real preference was stated by the group, but there was a recognition that the scenarios around the Denver metro area provide access to DIA without the delays of going through Denver. **Mountains –** The Mountain stakeholders expressed support for Scenarios A-1 and A-5 as they provide a direct link from the mountain corridor through DUS to DIA. One –seat ride and direct, convenient service between DIA and the mountain corridor is preferred.	**The public in each portion of the study area, with the exception of the Denver area, expressed a general preference for scenarios that offered them the most options in service.** **Fort Collins –** Stakeholders in this portion of the study area are most concerned that the commuter rail option on SH 287 be retained if HSR is built in the I-25 ROW. Scenario B2-A, like A-5 linked the northern cities with DIA and Colorado Springs. **Denver**- There was no clear direction given at the public meeting at Denver. Similar to the PLT so want access at DUS and others recognize the impacts associated with construction of A-1 and A-5 through the metro area. **Colorado Springs –** Public meeting participants were more focused on the dismissal of the alignment through the Black Forest than they were on expressing a strong preference for other scenarios. Support was expressed for the B2-A scenario over B-5 as it provides direct access to both DIA and the mountain corridor, with connections to Denver on the RTD system from the South Suburban station. One key concern is that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group. **Pueblo –** No real preference was stated by the group, but there was a recognition that the scenarios around the Denver metro area provide access to DIA without the delays of going through Denver. Scenario B-2A received the most support as it provides access to both DIA and the mountain corridor. **Mountains –** The Mountain stakeholders expressed very little support for Scenario B2-A as it was the longest route between the mountain corridor and DIA. It was viewed as out-of-direction travel for visitors heading to the mountains.	**The public in each portion of the study area, with the exception of the Denver area, expressed a general preference for scenarios that offered them the most options in service.** **Fort Collins –** Stakeholders in this portion of the study area are most concerned that the commuter rail option on SH 287 be retained if HSR is built in the I-25 ROW. B-5, like B2-A and A-5 linked the northern cities with DIA and Colorado Springs but also provided a direct link to the mountain corridor. Stakeholders in this portion of the study area preferred B-5 to B2-A and A-5. **Denver**- There was no clear direction given at the public meeting at Denver. Similar to the PLT so want access at DUS and others recognize the impacts associated with construction of A-1 and A-5 through the metro area. **Colorado Springs –** Public meeting participants were more focused on the dismissal of the alignment through the Black Forest than they were on expressing a strong preference for other scenarios. The least support was expressed for Scenario B-5. One key concern is that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group. **Pueblo –** No real preference was stated by the group, but there was a recognition that the scenarios around the Denver metro area provide access to DIA without the delays of going through Denver. **Mountains –** Of the scenarios that travel around the Denver metro area, Scenario B-5 had the highest support. .	**The public in each portion of the study area, with the exception of the Denver area, expressed a general preference for scenarios that offered them the most options in service.** **Fort Collins –** Stakeholders in this portion of the study area are most concerned that the commuter rail option on SH 287 be retained if HSR is built in the I-25 ROW. Although some residents favored the direct access provided by A-1 to DUS, others preferred better access to DIA, as provided by A-5, B-2A and B-5. **Denver**- There was no clear direction given at the public meeting at Denver. Similar to the PLT so want access at DUS and others recognize the impacts associated with construction of A-1 and A-5 through the metro area. **Colorado Springs –** Public meeting participants were more focused on the dismissal of the Black Forest alignment than selecting a preferred scenario. There was no real preference or support stated for the C-1 Scenario. One key concern is that the implementation of any of the scenarios would require new taxes for funding. New taxes were not supported by most of the group. **Pueblo –** No clear support for the C-1 Scenario. **Mountains –** The Mountain stakeholders are not in favor of C-1 because it would prohibit a one-seat ride with Maglev technology.

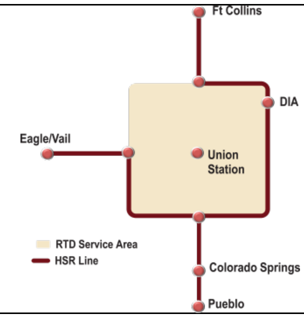
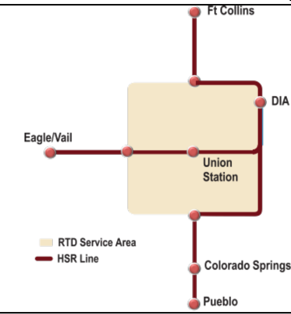
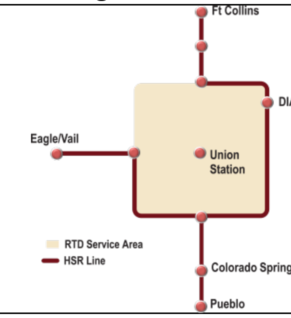
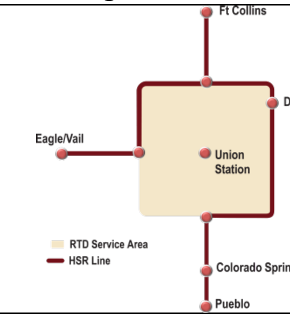
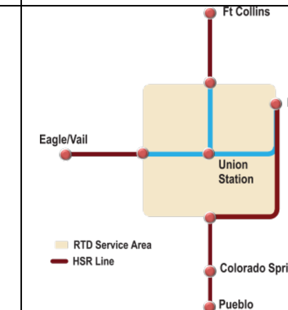
Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
• Agency support	• Summary of PLT comments	Generally, the PLT was concerned that the NEPA process would be prolonged and sufficiently contentious as to preclude the implementation of Scenarios A-1 and A-5, making them less preferable than those that travel around the Denver metro area.	Generally, the PLT was concerned that the NEPA process would be prolonged and sufficiently contentious as to preclude the implementation of Scenarios A-1 and A-5, making them less preferable than those that travel around the Denver metro area.	In general the PLT was more supportive of the scenarios that travel around the Denver metro area – Scenarios B-2A and B-5 – than those that travel through this area – Scenarios A-1 and A-5. A key concern of the PLT, however, continues to be the need to move riders into downtown Denver in addition to DIA.	In general the PLT is more supportive of the scenarios that travel around the Denver metro area – Scenarios B-2A and B-5 – than those that travel through this area – Scenarios A-1 and A-5. A key concern of the PLT, however, continues to be the need to move riders into downtown Denver in addition to DIA.	Due to the lower ridership Scenario C-1 was not strongly supported as a long term solution. However, it was noted that this scenario is a possible implementation strategy for steel wheel on rail technology.
• CDOT Regional support	• High/Medium/Low (based on one-on-one meetings with CDOT Regions 2, 4, 6)	At the Level 2 Evaluation, CDOT has not shown a strong preference of any one of the full build scenarios over the other. However, it has been determined at the conclusion of the Level 2 Evaluation that the segment traveling north to Fort Collins will likely not be permitted in the I-25 median as this ROW is being considered for tolled (managed) lanes.	At the Level 2 Evaluation, CDOT has not shown a strong preference of any one of the full build scenarios over the other. However, it has been determined at the conclusion of the Level 2 Evaluation that the segment traveling north to Fort Collins will likely not be permitted in the I-25 median as this ROW is being considered for tolled (managed) lanes.	At the Level 2 Evaluation, CDOT has not shown a strong preference of any one of the full build scenarios over the other. However, it has been determined at the conclusion of the Level 2 Evaluation that the segment traveling north to Fort Collins will likely not be permitted in the I-25 median as this ROW is being considered for tolled (managed) lanes.	At the Level 2 Evaluation, CDOT has not shown a strong preference of any one of the full build scenarios over the other. However, it has been determined at the conclusion of the Level 2 Evaluation that the segment traveling north to Fort Collins will likely not be permitted in the I-25 median as this ROW is being considered for tolled (managed) lanes.	At the Level 2 Evaluation, CDOT has not shown a strong preference of any one of the full build scenarios over the other. However, it has been determined at the conclusion of the Level 2 Evaluation that the segment traveling north to Fort Collins will likely not be permitted in the I-25 median as this ROW is being considered for tolled (managed) lanes.
• RTD support	• High/Medium/Low (based on one-on-one meeting with RTD)	At the Level 2 Evaluation, RTD has expressed some preference for A-1 direct routing through Denver and DUS. RTD would like to see an integrated system out of DUS, but recognizes the physical challenges of bringing HSR into the area.	At the Level 2 Evaluation, RTD has expressed some preference for A-5 direct routing through Denver and DUS. RTD would like to see an integrated system out of DUS, but recognizes the physical challenges of bringing HSR into the area.	At the Level 2 Evaluation, RTD has supported consideration of the scenarios that travel around the Denver metro area, but recognizes the need for connections to the RTD system at the periphery and the need for move riders into downtown Denver.	At the Level 2 Evaluation, RTD has supported consideration of the scenarios that travel around the Denver metro area, but recognizes the need for connections to the RTD system at the periphery and the need for move riders into downtown Denver.	RTD's opinion on Scenario C-1 cannot be determined until the details of the joint operating plan are determined in the Level 3 Evaluation.
Transportation Benefits						
• One seat ride: Mountains/DIA/DUS	• Yes/No transfer required	Yes with either option A or B.	Yes with either option A or B. However, persons traveling from the north or south will have a less direct route than with Scenario A-1.	Yes one-seat ride to DIA and mountains but persons traveling from the north will have a less direct route west to the mountains. A transfer to RTD would be required for DUS service.	Yes one-seat ride to DIA and mountains but persons traveling from the south will have a less direct route west to the mountains. A transfer to RTD would be required for DUS service.	It would be possible to have a one seat ride if FRA compliant technology were used. If non-FRA complaint technology, for example Maglev, was used in some segments, a transfer would be required.
• System Ridership	• Total annual ridership	Option A = 12. 1 million Option B = 13.1 million	Option A = 12. 9 million Option B = 13.1 million	13.8 million	13.7 million	10.8 million
• Generates improvements to and integrates with existing HSIPR/HST & Intercity Service including direct connections with local transit systems	• # of connections to local transit (RTD, Mason Street BRT, Colorado Springs Depot)	**Connection to RTD** - Connects with the RTD system at the West Suburban, South Suburban, DIA, DUS and the North Suburban stations with Option B. Option A does not connect with DUS. **North** - Connections with local transit in Fort Collins, Loveland and Longmont would be better when A-1 is paired with the N-1 Railroad (SH 287) alignment. However, total ridership is anticipated to be higher with use of N-2, I-25 alignment. **South** – connections to local transit are equal with all scenarios as the station stops are the same for each scenario.	**Connection to RTD –** Essentially the same connectivity as A-1. Like A-1, Option A does not connect with DUS. **North –** Same as Scenario A-1 options. **South** – Same as Scenario A-1.	**Connection to RTD –** Connects to the RTD system at the perimeter stations – north suburban (North Metro end of line), south suburban (SE extension end of line), and west suburban (West end of line). No direct HSIPR connections at central Denver RTD station(s). **North –** Same as Scenario A-1 options. **South** – Same as Scenario A-1.	**Connection to RTD –** As with B-2, connections to RTD are at perimeter suburban stations. **North –** Same as Scenario A-1 options. **South** – Same as Scenario A-1.	**Connection to RTD –** Because C-1 uses RTD tracks, C-1 has the highest potential connections with RTD system. The operating plan, however, envisions limited stops along the RTD system so service would be similar to A-1 and A-5, with stops at DUS and the suburban stations. **North –** Same as Scenario A-1 options. **South** – Same as Scenario A-1.

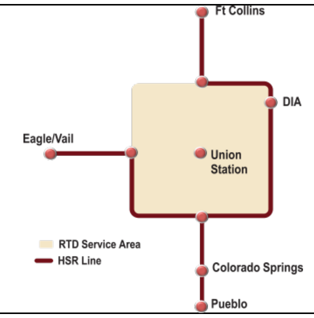
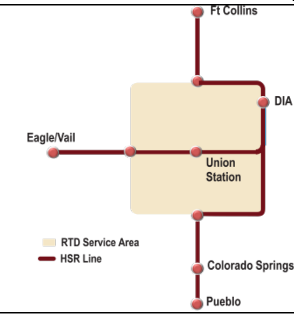
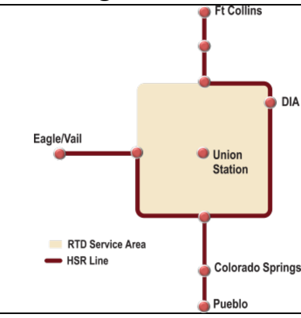
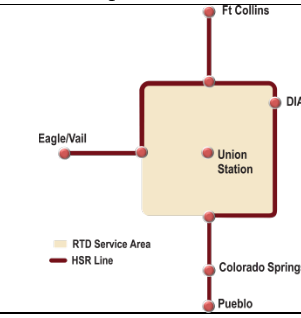
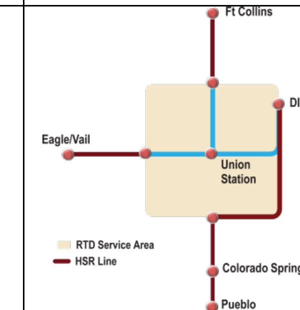
		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
Criterion						
• Generates cross-modal benefits – including favorable impacts on highway and aviation congestion	• Reduction in highway VMT (from TDM) • Percentage of airport trip diversions (from TDM)	**Denver area** – Since approximately 80 percent of the ridership represents inter-city travel, the impact on Denver area highway will be modest but positive. About 8,200 to 8,300 transit riders per day will use the HS stations in the Denver area, with Option A (I-76), or Option B (US 6), respectively. In general Option A (I-76) provides more ridership to DIA and Option B (US 6) provides more riders to DUS. The reduced ridership to DUS under Option A is due to a long transfer required from a station located at I-76/72nd Street to DUS. **North** – Daily ridership using the north stations averages about 6,900 to 8,200 per day with the higher value resulting from using Option B (US 6). This will have a favorable impact on I-25 north but is not sufficient to eliminate a future lane on I-25. **South** – Daily ridership from the south will range from 18,200 to 18,900, with Option B (US 6) representing the higher estimate. This will have a positive impact on the operations of I-25 south and may allow deferring the construction of a future lane on the highway between Denver and Colorado Springs in 2035. **West** - Daily ridership using the west stations averages about 7,200 to 8,400 per day with the higher value resulting from using Option B (US 6). This will have a favorable impact on I-70 operations but is not sufficient to eliminate a future lane on the highway. **Aviation** – Approximately 4 percent of the total ridership represents diversion from aviation to HSR.	**Denver area** –Scenario A-5 represents slightly more transit riders using the Denver area stations. About 8,700 to 9,600 transit riders per day will use the HS stations in the Denver area, with Option A (I-76), or Option B (US 6), respectively. Option A (I-76) and Option B (US 6) provides about the same number of riders to DIA. Under this scenario Option A provides no riders to DUS. **North** – Daily ridership north is higher with A-5, with riders using the north stations averaging from 7,700 to 8,700 per day with the higher value resulting from using Option B (US 6). This will have a favorable impact on I-25 north but is not sufficient to eliminate a future lane on I-25. **South** – Daily ridership going south will range from 18,400 to 18,600, with Option A (I-76) representing the higher estimate. Like A-1, A-5 will have a positive impact on the operations of I-25 south and may allow deferring the construction of a future lane on the highway between Denver and Colorado Springs in 2035. **West** - Daily ridership using the west stations averages about 7,100 to 8,100 per day with the higher value resulting from using Option A (I-76). Again, this will have a favorable impact on I-70 operations but is not sufficient to eliminate a future lane on the highway. **Aviation** – Approximately 5 percent of the total ridership represents diversion from aviation to HSR. This is same with either Option A or B.	**Denver area** –With Scenario B-2A the number of Denver area transit users is about 15 percent of the total, or 7,100 per day. This is the lowest of the five scenarios. **North** – Daily ridership from the north is estimated at 8,300. Again, this will have a favorable impact on I-25 North but is not sufficient to eliminate a future lane on I-25. **South** – Daily ridership going south is estimated at 20,700. This is the highest of the five scenarios evaluated. This impact is likely sufficient to eliminate a future lane on I-25. **West** - Daily ridership using the west stations is estimated at about 10,000 per day which is the best of the five scenarios evaluated. This would have a positive impact on I-70 West but is not sufficient to defer the need for a future highway lane. **Aviation** – Approximately 4 percent of the total ridership represents diversion from aviation to HSR.	**Denver area** –With Scenario B-5 the number of Denver area transit users is about 16 percent of the total, or 7,400 per day. This is the second lowest of the five scenarios. **North** – Daily ridership from the north is estimated at 10,400. This is the highest of the five scenarios evaluated. Again, this will have a favorable impact on I-25 North but is not sufficient to eliminate a future lane on I-25. **South** – Daily ridership going south is estimated at 18,600, which is comparable to scenarios A-1 and A-5 but lower than B-2A. This impact is likely sufficient to eliminate a future lane on I-25. **West** - Daily ridership using the west stations is estimated at about 9,300 per day which is the second best of the five scenarios evaluated. This would have a positive impact on I-70 West but is not sufficient to defer the need for a future highway lane. **Aviation** – Approximately 4 percent of the total ridership represents diversion from aviation to HSR.	**Denver area** –With Scenario C-1 the number of Denver area transit users remains about 20 percent of the total; however the absolute numbers are reduced by 255,000 over A-1 paired with Option B (US 6) to 621,000 over A-5 paired with Option B. **North** – Daily ridership north is estimated at 6,400. This compares to 8,200 with A-1 paired with Option B (US 6) and 8,700 with A-5 paired with Option B. **South** – Daily ridership going south is estimated at 16,600. This compares to 18,900 with A-1 paired with Option B (US 6) and 18,600 with A-5 paired with Option A (I-76). Like A-1 and A-5, C-1 will have a positive impact on the operations of I-25 south and may allow deferring the construction of a future lane on the highway between Denver and Colorado Springs in 2035. **West** - Daily ridership using the west stations is estimated at about 5,600 per day or over 40 percent lower than with scenarios A-1 and A-5. Again, this will have a favorable impact on I-70 operations but is not sufficient to eliminate a future lane on the highway. **Aviation** – Approximately 6 percent of the total ridership represents diversion from aviation to HSR.
• Enhancing intercity travel options	• Yes/No	Yes. Scenarios A-1A and A-1B generate 84 percent of total ridership as intercity trips.	Yes. Scenarios A-5A and A-5B generate 75 and 76 percent of total ridership as intercity trips, respectively.	Yes. Scenario B-2A generates 77 percent of total ridership as intercity trips.	Yes. Scenario B-5 generates 75 percent of total ridership as intercity trips.	Yes. Scenario B-5 generates 78 percent of total ridership as intercity trips. However, the absolute numbers are lower because the total ridership is also lower.
• Requires standardized rolling stock, signaling, communications and power equipment	• Yes/No	No. Technology options remain open.	No. Technology options remain open.	No. Technology options remain open.	No. Technology options remain open.	Yes. C-1 would require the use of FRA compliant technology, or it would require a transfer if non-FRA compliant technology, e.g. Maglev, were used in other segments of the system.

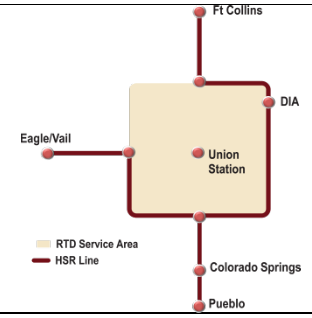
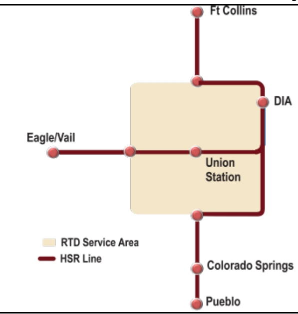
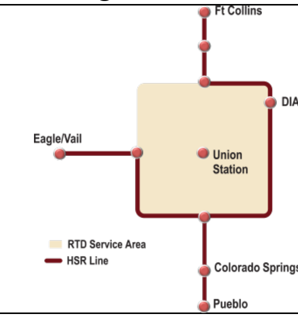
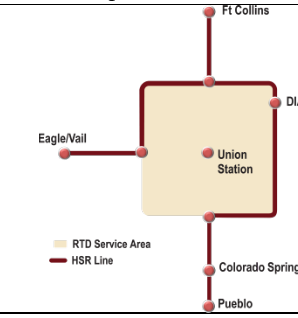
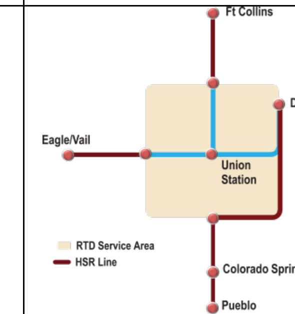
Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
• Improved freight operations and equitable railroad financial participation commensurate with benefits received	• Yes/No/Not Applicable	Not Applicable. No impact on freight operations is expected, as track or ROW is not shared with the freight railroads. Because the north to south alignment parallels the CML/Joint Line south through Denver, it represents that highest potential for future conflicts with the RR companies.	Not Applicable. None of the component segments would affect RR operations as all segments are separated from RR owned ROW.	Not Applicable. None of the component segments would affect RR operations as all segments are separated from RR owned ROW.	Not Applicable. None of the component segments would affect RR operations as all segments are separated from RR owned ROW.	Not Applicable. Similar to the full build scenarios, C-1 would not impact freight railroad operations.
• Improved commuter rail (RTD) operations and equitable financial participation commensurate with benefits received	• Yes/No/Not Applicable	Not Applicable. The scenario Is anticipated to have negligible impacts, either positive or negative on RTDs proposed East Line, Gold Line or North Metro CRT systems. There may be some concern that this scenario would compete with RTD; however, the ridership estimation studies have strongly suggested that HSR does not effectively compete with RTD because the fare structure is so much higher for HSR.	Not Applicable. The scenario Is anticipated to have negligible impacts, either positive or negative on RTDs proposed East Line, Gold Line or North Metro CRT systems. There may be some concern that this scenario would compete with RTD; however, the ridership estimation studies have strongly suggested that HSR does not effectively compete with RTD because the fare structure is so much higher for HSR.	Yes. This scenario would provide direct connections to RTD system and is expected to have a negligible positive impact on RTD's ridership. The scenario would not compete with RTD's system.	Yes. This scenario would provide direct connections to RTD system and is expected to have a negligible positive impact on RTD's ridership. The scenario would not compete with RTD's system.	Yes. The addition of the HSR trains on RTDs commuter rail system would improve the utilization of existing transit investments but would complicate the operations plan and likely require investment for adding double track to sections currently single-tracked.
• Encourages Positive Train Control (PTC) implementation	• Yes/No	No. Would have no impact on the implementation of PTC in existing freight corridors as no track is shared between passenger and freight services.	No. Would have no impact on the implementation of PTC in existing freight corridors as no track is shared between passenger and freight services.	No. Would have no impact on the implementation of PTC in existing freight corridors as no track is shared between passenger and freight services.	No. Would have no impact on the implementation of PTC in existing freight corridors as no track is shared between passenger and freight services.	No. Would have no impact on the implementation of PTC in existing freight corridors as no track is shared between passenger and freight services.
• Incorporates private investment in the financing of the project	• Yes/No	Unknown at Level 2, as the financial plan for the selected alternative will be defined in the project implementation plan after the selection of a preferred alternative.	Unknown at Level 2, as the financial plan for the selected alternative will be defined in the project implementation plan after the selection of a preferred alternative.	Unknown at Level 2, as the financial plan for the selected alternative will be defined in the project implementation plan after the selection of a preferred alternative.	Unknown at Level 2, as the financial plan for the selected alternative will be defined in the project implementation plan after the selection of a preferred alternative.	Unknown at Level 2, as the financial plan for the selected alternative will be defined in the project implementation plan after the selection of a preferred alternative.
• Promotes equity of service	• Equitable distribution of service	This scenario provides service to the north, south and west of Denver.	This scenario provides service to the north, south and west of Denver.	This scenario provides service to all parts of the Front Range and the Mountains; however, representative traveling from the Mountain Communities have stated that they believe that they would be forced to travel out of direction to access DIA. However, it is interesting to note that nearly 10,000 riders per day would use HSR stations located in the mountain region which is the highest of the five scenarios evaluated.	This scenario provides service to all parts of the Front Range and the Mountains. Access to the Mountain Communities from the south is less direct than for B-2A but is comparable to the other scenarios.	Equity of service is provided with C-1 but to a lesser extent than with the full build scenarios due to lower ridership.
Other Public Benefits						
• Environmental quality and energy efficiency ▪ Reduction of dependence on foreign oil, including the use of renewable resources	• Reduction in VMT	Reduction in VMT is: • Option A = 360.4 million • Option B = 396.0 million	Reduction in VMT is: • Option A = 351.2 million • Option B = 351.4 million	Reduction in VMT is: • 373.8 million	Reduction in VMT is: • 357.4 million	Reduction of VMT is less than for the full build scenarios: • 271 million
▪ Employment of green building and manufacturing methods	• Potential for LEED certification	Not a discriminator as any of the full build scenarios could be constructed with green methods.	Not a discriminator as any of the full build scenarios could be constructed with green methods.	Not a discriminator as any of the full build scenarios could be constructed with green methods.	Not a discriminator as any of the full build scenarios could be constructed with green methods.	Scenario C-1 may represent a slight advantage because the use of existing infrastructure versus construction of new guideway though metro Denver would be viewed favorably.

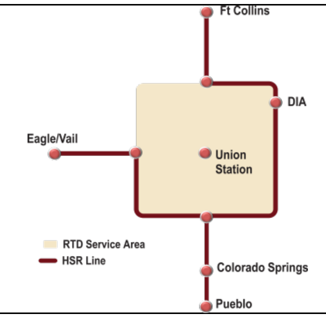
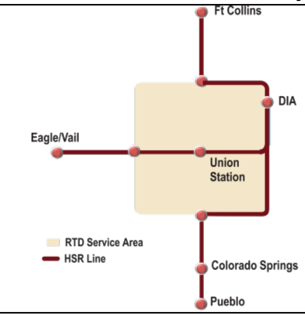
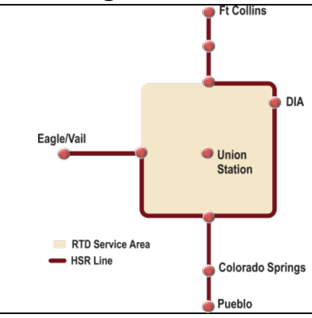
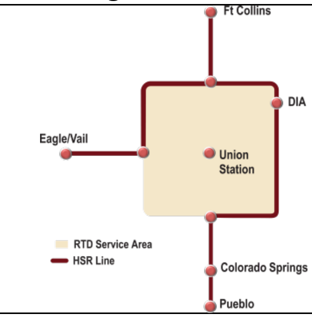
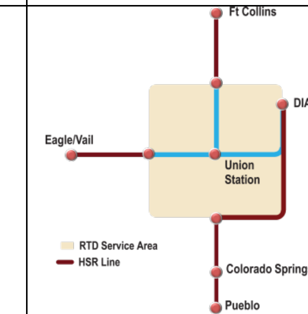
Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
▪ Reduction of key emission types	• Benefit is proportionate to the reduction in VMT.	In general, this scenario represents a positive impact to air quality. Paired with Option B, this scenario results in the highest reduction in VMT of all the scenarios at 396.0 million (about 10 to 12 percent greater reductions than other full build scenarios). However, when compared against regional VMT, all scenarios offer comparable air quality benefits.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (11 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (6 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (10 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Less air quality benefit than the full build out scenarios because VMT reductions are 23 to 31 percent less.
• Promotes livable communities, complementing local governmental efforts to promote efficient land use planning	• See "Consistency with local land use planning" below under Planning Feasibility.	See "Consistency with local land use planning" below under Planning Feasibility.	See "Consistency with local land use planning" below under Planning Feasibility.	See "Consistency with local land use planning" below under Planning Feasibility.	See "Consistency with local land use planning" below under Planning Feasibility.	See "Consistency with local land use planning" below under Planning Feasibility.
• Improving historic transportation facilities	• Yes/No	Not a discriminator. For alignment south of Denver, there is a potential to reuse historic stations in Castle Rock, Colorado Springs and Pueblo.	Not a discriminator. For alignment south of Denver, there is a potential to reuse historic stations in Castle Rock, Colorado Springs and Pueblo.	Not a discriminator. For alignment south of Denver, there is a potential to reuse historic stations in Castle Rock, Colorado Springs and Pueblo.	Not a discriminator. For alignment south of Denver, there is a potential to reuse historic stations in Castle Rock, Colorado Springs and Pueblo.	Not a discriminator. For alignment south of Denver, there is a potential to reuse historic stations in Castle Rock, Colorado Springs and Pueblo.
Environmental Impact						
▪ Air quality	• VMT and emission calculations	In general, this scenario represents a positive impact to air quality. Paired with Option B, this scenario results in the highest reduction in VMT of all the scenarios at 396.0 million (about 10 to 12 percent greater reductions than other full build scenarios). However, when compared against regional VMT, all scenarios offer comparable air quality benefits.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (11 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (6 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Similar air quality benefit to Scenario A-1, although slightly less (10 percent) reduction in VMT than A-1b.	In general, this scenario represents a positive impact to air quality. Less air quality benefit than the full build out scenarios because VMT reductions are 23 to 31 percent less.
▪ Noise	• Linear miles of alignments near sensitive receptors	**Total: 41.20 to 36.04 linear miles** **Denver area** – 27.23 linear miles (option a); 30.83 linear miles (option b) **North** – 0 to 10.75 linear miles (option for I-25 alignment generally quarter-mile or farther from receptors) **South** – 9.37 linear miles **West** – not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 36.53 to 22.73 linear miles** **Denver area** – 13.36 linear miles (option a); 16.97 linear miles (option b) **North** – 0 to 10.75 linear miles (option for I-25 alignment generally quarter-mile or farther from receptors) **South** – 9.37 linear miles **West** – not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 30.39 to 20.20 linear miles** **Denver area** – 10.83 miles **North** – 0 to 10.75 linear miles (option for I-25 alignment generally quarter-mile or farther from receptors) **South** – 9.37 linear miles **West** – not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 29.37 to 19.18 linear miles** **Denver area** – 9.25 linear miles **North** – 0 to 10.75 linear miles (option for I-25 alignment generally quarter-mile or farther from receptors) **South** – 9.37 linear miles **West** – not yet evaluated (awaiting final AGS alignments)	**Total: 37.02 to 26.83 linear miles** **Denver area** – 17.46 linear miles **North** – 0 to 10.75 linear miles (option for I-25 alignment generally quarter-mile or farther from receptors) **South** – 9.37 linear miles **West** – not yet evaluated (awaiting final AGS alignments)
▪ Energy and congestion	• VMT and energy usage calculations[i]	Btu reduction from VMT reduction: • Option A = 2.65 billion • Option B = 2.91 billion	Btu reduction from VMT reduction: • Option A = 2.58 billion • Option B = 2.58 billion	Btu reduction from VMT reduction: • 2.74 billion	Btu reduction from VMT reduction: • 2.62 billion	Btu reduction from VMT reduction: • 1.99 billion

Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
▪ Initial and permanent employment changes[ii]	• # of construction jobs created (including direct and spinoff jobs) (Average per year over a 10 yr construction period) • # of operations jobs (include direct and secondary employment)	**Temporary jobs**: Approximately 29,700 per year for A-1A and 29,000 for A-1B including both construction and 'spin-off' jobs. **Permanent jobs**: 2,110 per year for A-1A and 2,120 for A-1B including both operations jobs and spin-off jobs	**Temporary jobs**: Approximately 27,300 per year for A-5A and 27,600 for A-5B including both construction and 'spin-off' jobs. **Permanent jobs**: 2,150 per year for A-5A and A-5B including both operations jobs and spin-off jobs	**Temporary jobs**: Approximately 25,900 per year including both construction and 'spin-off' jobs. **Permanent jobs**: 2,380 per year including both operations jobs and spin-off jobs. **10,727** 10,727	**Temporary jobs**: Approximately 27,000 per year including both construction and 'spin-off' jobs. **Permanent jobs**: 2,390 per year including both operations jobs and spin-off jobs.	**Temporary jobs**: Approximately 22,200 per year including both construction and 'spin-off' jobs. **Permanent jobs**: 2,180 per year including both operations jobs and spin-off jobs.
▪ Land use and development effects, including TOD potential	• # of communities with land use conflicts • acres of ROW required	**Not a discriminator** - Because the stations are essentially the same for all scenarios the anticipated TOD impact is the same as well. For the Benefit/Cost analysis the impact was calculated at $3.1 Billion. **Acres of ROW required** = 1,587 for A-1A and 1,445 for A-1B.	**Not a discriminator** - Because the stations are essentially the same for all scenarios the anticipated TOD impact is the same as well. For the Benefit/Cost analysis the impact was calculated at $3.1 Billion. **Acres of ROW required** = 1,405 for A-5A and 1,399 for A-5B	**Not a discriminator** - Because the stations are essentially the same for all scenarios the anticipated TOD impact is the same as well. For the Benefit/Cost analysis the impact was calculated at $3.1 Billion. **Acres of ROW required** = 1,241	**Not a discriminator** - Because the stations are essentially the same for all scenarios the anticipated TOD impact is the same as well. For the Benefit/Cost analysis the impact was calculated at $3.1 Billion. **Acres of ROW required** = 1,496	**Not a discriminator** - Because the stations are essentially the same for all scenarios the anticipated TOD impact is the same as well. For the Benefit/Cost analysis the impact was calculated at $3.1 Billion. **Acres of ROW required** = 904 (least of all scenarios)
▪ Community Disruption	• Linear miles of alignments adjacent to residences, commercial businesses, employment centers, and community facilities	**Total: 41.76 to 36.6 linear miles** **Denver area** – 27.23 linear miles (option a); 30.83 linear miles (option b) **North** – 0.56 to 10.75 linear miles (I-25 alignment not directly adjacent to communities) **South** – 9.37 linear miles **West –** not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 37.09 to 23.29 linear miles** **Denver area** – 13.36 linear miles (option a); 16.97 linear miles (option b) **North** – – 0.56 to 10.75 linear miles (option for I-25 alignment generally avoids noise impacts to communities) **South** – 9.37 linear miles **West –** not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 30.95 to 20.76 linear miles** **Denver area** – 10.83 miles **North** – 0.56 to 10.75 linear miles (option for I-25 alignment generally avoids noise impacts to communities) **South** – 9.37 linear miles **West –** not yet evaluated (awaiting final AGS alignments)	**Total: linear miles: 29.37 to 19.18 linear miles** **Denver area** – 9.25 linear miles **North** – 0.56 to 10.75 linear miles (option for I-25 alignment generally avoids noise impacts to communities) **South** – 9.37 linear miles **West –** not yet evaluated (awaiting final AGS alignments)	**Total: 37.58 to 27.39 linear miles** **Denver area** – 17.46 linear miles **North** – 0.56 to 10.75 linear miles (option for I-25 alignment generally avoids noise impacts to communities) **South** – 9.37 linear miles **West –** not yet evaluated (awaiting final AGS alignments)
▪ Safety	• # of new at-grade crossings • VMT reduction	All crossings are grade separated. Modest health benefits from reduced VMT.	All crossings are grade separated. Modest health benefits from reduced VMT.	All crossings are grade separated. Modest health benefits from reduced VMT.	All crossings are grade separated. Modest health benefits from reduced VMT.	Numerous at-grade crossings on RTD's system would be shared with HSIPR. Modest health benefits from reduced VMT less than other scenarios due to lesser VMT reductions.

Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
▪ Hazardous waste	• # of Superfund sites traversed by alignments and stations	Construction through the Denver metro area would increase the potential of conflicts with hazardous waste, especially when compared to Scenarios B-2A and B-5. Both options border Rocky Mountain Arsenal's northwest border and cross (remediated) Denver Radium Site (DRS) in 2 Locations. The potential for conflicts with hazardous waste north to Fort Collins is unknown but felt to be a low risk as nearly all construction would be located in the E-470 and I-25 rights-of-way. However, since all five scenarios share the alignment north, this is not a Level 2 Evaluation discriminator. Potential conflicts with hazard wastes associated with HSR construction through Castle Rock, Colorado Springs and Pueblo are unknown. However, since all five scenarios share the alignment south, this is not a Level 2 Evaluation discriminator.	Construction through the Denver metro area would increase the potential of conflicts with hazardous waste, especially when compared to Scenarios B-2A and B-5. Both options border Rocky Mountain Arsenal's northwest border. The potential for conflicts with hazardous waste north to Fort Collins is unknown but felt to be a low risk as nearly all construction would be located in the E-470 and I-25 rights-of-way. However, since all five scenarios share the alignment north, this is not a Level 2 Evaluation discriminator. Potential conflicts with hazard wastes associated with HSR construction through Castle Rock, Colorado Springs and Pueblo are unknown. However, since all five scenarios share the alignment south, this is not a Level 2 Evaluation discriminator.	This scenario borders Lowry Landfill's Environmental Protection/Cleanup Trust Buffer. Because this scenario does not penetrate the industrial areas within the Denver metro area, it is felt to represent lesser potential for conflicts with hazardous waste than Scenarios A-1 and A-5. The potential for conflicts with hazardous waste north to Fort Collins is unknown but felt to be a low risk as nearly all construction would be located in the E-470 and I-25 rights-of-way. However, since all five scenarios share the alignment north, this is not a Level 2 Evaluation discriminator. Potential conflicts with hazard wastes associated with HSR construction through Castle Rock, Colorado Springs and Pueblo are unknown. However, since all five scenarios share the alignment south, this is not a Level 2 Evaluation discriminator.	This scenario traverses eastern portion of Rocky Flats boundary (cleared for development) and borders Lowry Landfill's Environmental Protection/Cleanup Trust Buffer. Because this scenario does not penetrate the industrial areas within the Denver metro area, it is felt to represent lesser potential for conflicts with hazardous waste than Scenarios A-1 and A-5. The potential for conflicts with hazardous waste north to Fort Collins is unknown but felt to be a low risk as nearly all construction would be located in the E-470 and I-25 rights-of-way. However, since all five scenarios share the alignment north, this is not a Level 2 Evaluation discriminator. Potential conflicts with hazard wastes associated with HSR construction through Castle Rock, Colorado Springs and Pueblo are unknown. However, since all five scenarios share the alignment south, this is not a Level 2 Evaluation discriminator.	Sharing track with RTD's system is anticipated to require some conversion of single track on East Rail and Gold Line alignments. Since these alignments penetrate through industrial areas, there is the strong potential that conflicts with hazardous waste will occur. The potential for conflicts with hazardous waste north to Fort Collins is unknown but felt to be a low risk as nearly all construction would be located in the E-470 and I-25 rights-of-way. However, since all five scenarios share the alignment north, this is not a Level 2 Evaluation discriminator. Potential conflicts with hazard wastes associated with HSR construction through Castle Rock, Colorado Springs and Pueblo are unknown. However, since all five scenarios share the alignment south, this is not a Level 2 Evaluation discriminator.
▪ Historic properties	• # of NRHP-listed properties potentially affected by alignments and stations	**Denver area –** 2 properties potentially affected (Intersects Riverside Cemetery, Borders Historic Flour Mill Lofts) **North –** 2 properties potentially affected (Longmont College, Southern Railway Depot) **South –** 3 properties potentially affected (Rock Island Interurban Roundhouse, Reynolds Ranch, Castle Rock Depot) **West –** not yet evaluated (awaiting final AGS alignments)	**Denver area –** 2 properties potentially affected (Intersects Riverside Cemetery, Borders Historic Flour Mill Lofts) **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: 1 property potentially affected (Dinosaur Ridge/North Dinosaur Park property). **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: No properties affected. **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: Construction from Gold Line to West Line borders Golden Welcome Arch under SH 58 option. Generally assume no properties affected on shared track (double tracking could be required as the operating plan is refined in Level 3). **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1

Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
▪ Park and recreation facilities	• # of properties potentially affected • Linear miles adjacent to or within parks	**Denver area**: *Option A*: 7 affected properties (Johnson Park, Applewood Park, Golden Heights Park, Thunder Valley Park, North Dinosaur Park, Fairfax Park, Rocky Mountain Arsenal National Wildlife Refuge); 4.85 linear miles *Option B*: 9 affected properties (Union Ridge, Frog Hollow Park, Barnum Park, Jefferson County Fairgrounds, Golden Heights Park, Thunder Valley Park, North Dinosaur Park, Fairfax Park, Rocky Mountain Arsenal National Wildlife Refuge); 5.35 linear miles **North**: *Railroad alignment option*: 8 affected properties (Sandstone Ranch Community Park, Collyer Park, Loveland Burrial Park, Long View Farm Open Space, Colina Mariposa Natural Area, Hazaleus Natural Area, two unnamed parks); 4.62 linear miles. *I-25 option:* 3 affected properties (Arapahoe Bend Natural Area, Fossil Creek Reservoir Natural Area, FCAA Archery Range); 0.88 linear miles **South**: 3 affected properties (Gossage Youth Sports Complex, Monument Valley Park); 1.17 linear miles **West**: not yet evaluated (awaiting final AGS alignments)	**Denver area**: *Option A:* 6 affected properties (Johnson Park, Applewood Park, Golden Heights Park, Thunder Valley Park, North Dinosaur Park, Rocky Mountain Arsenal National Wildlife Refuge); 4.85 linear miles *Option B*: 8 affected properties (Union Ridge, Frog Hollow Park, Barnum Park, Jefferson County Fairgrounds, Golden Heights Park, Thunder Valley Park, North Dinosaur Park); 5.35 linear miles **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: 3 affected properties (William F Hayden Green Mountain Park, Mount Glennon, Chatfield State Park); 4.55 linear miles **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: 9 affected properties (Siena Reservoir, Carolyn Holmberg Preserve at Rock Creek Farm, Glacier Park, Colorado Hills Open Space, Rocky Flats National Wildlife Refuge, North Table Mountain Park, White Ash Mine Park, Mt Galbraith Park, Tin Cup Hogback Park); 6.73 linear miles **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1	**Denver area**: Construction from Gold Line to West Line affects 1 property (Tin Cup Hogback Park) (SH 58 option) or 4 properties (Applewood Park, Golden Heights Park, Thunder Valley Park, North Dinosaur Park) under I-70 option. Generally assume no properties affected on shared track (double tracking could be required as the operating plan is refined in Level 3; visual/noise effects will also be considered in Level 3). **North**: Same as A-1 **South**: Same as A-1 **West**: Same as A-1
▪ Wetlands and water resources	• # of stream crossings • # of wetland crossings • # of levee crossings • linear miles of streams adjacent to alignments	**Denver area**: 9 stream crossings 3 wetland crossings 1 levee crossing 1.30 linear miles adjacent to streams	**Denver area**: 11 stream crossings 7 wetland crossings 1 levee crossing 0.49 linear miles	**Denver area**: 20 stream crossings 13 wetland crossings 1 levee crossing 0.83 linear miles	**Denver area**: 22 stream crossings 18 wetland crossings 1 levee crossing 0.82 linear miles	**Denver area**: Construction from Gold Line to West Line has 7 stream crossings, 5 wetland crossings, and 1.04 linear miles adjacent to streams under SH58 option and 5 stream crossings, 3 wetland crossings, and 0.75 linear miles adjacent to streams on I-70 option. Use of shared track has no impacts to water resources (double tracking could be required as the operating plan is refined in Level 3).
Engineering and Institutional Feasibility						
• Capital Cost (CAPEX)	• Dollars	A-1A = $15.3 billion A-1B = $14.9 billion	A-5A = $14.1 billion A-5B = $14.3 billion	$13.4 billion	$13.9 billion	$11.5 billion
• Operating Cost/year	• Dollars	A-1A = $183.0 million/year A-1B = $183.5 million/year	A-5A = $186.1 million/year A-5B = $186.7 million /year	$206.0 million/year	$207.0 million/year	$189.2 million/year

Criterion		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
						
• Right-of-Way Costs	• Order of magnitude	A-1A and A-1B would likely be the highest ROW cost of the full build scenarios through the Denver metro area. Of these two scenarios, A-1B is anticipated to be the highest of all scenarios. ROW cost to Fort Collins and to Pueblo would be the same for all scenarios and is not a discriminator.	A-5B would likely be the third highest ROW cost of the full build scenarios through the Denver metro area. A-5A would likely be less than A-5B but more than Scenarios B-2A and B-5. ROW cost to Fort Collins and to Pueblo would be the same for all scenarios and is not a discriminator.	B-2A is anticipated to have the least ROW cost of the full build scenarios through the Denver metro area. ROW cost to Fort Collins and to Pueblo would be the same for all scenarios and is not a discriminator.	B-5 is anticipated to have the second lowest ROW cost of the full build scenarios through the Denver metro area. ROW cost to Fort Collins and to Pueblo would be the same for all scenarios and is not a discriminator.	Compared to the full build scenarios, C-1 would have the lowest ROW cost due to the fact that it would require the least property acquisition in Denver metro area. ROW cost to Fort Collins and to Pueblo would be the same for all scenarios and is not a discriminator.
• Requires multiple technologies	• Yes/No /Not Applicable	Not Applicable. A preferred technology has not been determined in Level 2 Evaluation; either Maglev or steel wheel technology could be used on the A-1 alignments.	Not Applicable. A preferred technology has not been determined in Level 2 Evaluation; either Maglev or steel wheel technology could be used on the A-5 alignments.	Not Applicable. A preferred technology has not been determined in Level 2 Evaluation; either Maglev or steel wheel technology could be used on the B-2A alignments.	Not Applicable. A preferred technology has not been determined in Level 2 Evaluation; either Maglev or steel wheel technology could be used on the B-5 alignments.	C-1 would require more than one technology if a different technologies (such as Maglev) were used for the Mountain Corridor.
• Availability of technology (commercially available by 2020)	• Yes/No /Not Applicable	Not Applicable. This will be determined in Level 3 Evaluation.	Not Applicable. This will be determined in Level 3 Evaluation.	Not Applicable. This will be determined in Level 3 Evaluation.	Not Applicable. This will be determined in Level 3 Evaluation.	Yes. Use of the RTD track would require a technology that meets FRA compliance. This would force the selection of a technology that is currently commercially available.
• Ability to phase	• High, Medium, Low	Scenarios A-1A and A-1B are not as amenable to phasing as the other full build scenarios, as the logical first phase would involve construction from DIA to downtown Denver which is anticipated to be difficult. A second phase north to Fort Collins or south toward Colorado Springs would also be difficult.	Scenarios A-5, B-2A, B-5 and C-1 would all equally accommodate a first phase from DIA to Colorado Springs along the E-470 ROW. All scenarios but C-1 would allow a first phase to Fort Collins, again along the E-470 ROW.	Scenarios A-5, B-2A, B-5 and C-1 would all equally accommodate a first phase from DIA to Colorado Springs along the E-470 ROW. All scenarios but C-1 would allow a first phase to Fort Collins, again along the E-470 ROW.	Scenarios A-5, B-2A, B-5 and C-1 would all equally accommodate a first phase from DIA to Colorado Springs along the E-470 ROW. All scenarios but C-1 would allow a first phase to Fort Collins, again along the E-470 ROW.	As referenced for Scenarios A-5, B-2A and B-5, C-1 provides a potential phasing solution south to the Colorado Springs area. However, C-1 would make it difficult to construct an initial phase to Fort Collins.
Planning Feasibility						
• Consistent with the State Rail Plan	• High, Medium, Low	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening
• Consistency with Regional Transportation Plans	• Yes/No	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening	Yes. Addressed in Level 1 screening
• Consistent with local land use planning	• High, Medium, Low	Not a discriminator. None of the stations associated with the Level 2 Evaluation scenarios are included on local plans. No station area planning has occurred at this point in the project. Once a Preferred Alternative is identified and funded, CDOT would work with local government to assure that the final station locations are compatible with local land use planning.	Not a discriminator. None of the stations associated with the Level 2 Evaluation scenarios are included on local plans. No station area planning has occurred at this point in the project. Once a Preferred Alternative is identified and funded, CDOT would work with local government to assure that the final station locations are compatible with local land use planning.	Not a discriminator. None of the stations associated with the Level 2 Evaluation scenarios are included on local plans. No station area planning has occurred at this point in the project. Once a Preferred Alternative is identified and funded, CDOT would work with local government to assure that the final station locations are compatible with local land use planning.	Not a discriminator. None of the stations associated with the Level 2 Evaluation scenarios are included on local plans. No station area planning has occurred at this point in the project. Once a Preferred Alternative is identified and funded, CDOT would work with local government to assure that the final station locations are compatible with local land use planning.	Not a discriminator. None of the stations associated with the Level 2 Evaluation scenarios are included on local plans. No station area planning has occurred at this point in the project. Once a Preferred Alternative is identified and funded, CDOT would work with local government to assure that the final station locations are compatible with local land use planning.
• General potential for TOD	• High, Medium, Low	This is not a discriminator. The potential impact is estimated at $3.1 billion. However, all scenarios serve same stations.	This is not a discriminator. The potential impact is estimated at $3.1 billion. However, all scenarios serve same stations.	This is not a discriminator. The potential impact is estimated at $3.1 billion. However, all scenarios serve same stations.	This is not a discriminator. The potential impact is estimated at $3.1 billion. However, all scenarios serve same stations.	This is not a discriminator. The potential impact is estimated at $3.1 billion. However, all scenarios serve same stations.
Benefit Cost						
• Benefit Cost Ratio	• Ratio based on methodology in environmental methodology manual	A-1A = B/C of 1.98 A-1B = B/C of 2.03	A-5A = B/C of 2.0 A-5B = B/C of 2.03	B-2A = B/C of 2.01	B-5 = B/C of 1.99	C-1 = B/C of 1.97

		Scenario A-1: Direct Routing through Denver	Scenario A-5: Through Denver with Eastern Beltway	Scenario B-2A: Denver Periphery Excluding the NW Quadrant	Scenario B-5: Denver Periphery Excluding the SW Quadrant	Scenario C-1: Shared Track
Criterion						
• Operating Cost Ratio	• Revenue/OPEX	A-1A = Operating ratio of 1.32 A-1B = Operating ratio of 1.45	A-5A = Operating ratio of 1.32 A-5B = Operating ratio of 1.35	B-2A = Operating ratio of 1.21	B-5 = Operating ratio of 1.19	C-1 = Operating ratio of 1.05
Level 2 Screening Recommendation	• Carry Forward/Set Aside	**SET ASIDE**: • Performs well but results in high community impacts to the Denver metro area. • Scenarios A-5, B-2A and B-5 perform as well or better and generally cost less and result in fewer impacts. • Obtaining NEPA clearances though the Denver metro area would take long and be contentious eroding public support for the HSIPR program. • Last, it does not serve DIA from north or south well due to a lengthy transfer at DUS and competition from RTD's lower fares and good travel times.	**CARRY FORWARD (with Option b)**: • Performs as well as A-1 at lower cost and with fewer impacts at least in the north to south direction through Denver. • However, the impacts will be greater than for B-2A, B-5 or C-1, because it still involves construction through the Denver metro area in the east to west direction. • It serves DIA best with one-seat ride from all markets but requires more out-of-direction travel to the mountains from the north and south markets • It works well with either Option a (I-76) or Option b (US 6). Because Option b has severe community impacts and is likely to be contentious, it is recommended that only Option a be carried forward for further analysis.	**CARRY FORWARD**: • Generates the highest ridership, and the highest revenue; however the operating ratio is lower than A-1 or A-5. • Lowest capital cost of any of the full-build scenarios. • Avoids the community and environmental impacts of construction and operation through the Denver metro area. • The one key disadvantage of this scenario is that it does not provide service to DUS.	**SET ASIDE**: • While this scenario has many of the benefits of B-2A it is not supported by many of the Northwest Quadrant stakeholders and is considered to be much more difficult to implement than Scenario B-2A. The benefits of B-5 include: • Generates the second highest ridership and the second highest revenue; like B-2A the operating ratio of B-5 is lower than either A-1 or A-5. • Second lowest capital cost of any of the full-build scenarios. • Like B-2A, avoids the community and environmental impacts of construction and operation through the Denver metro area. • Like B-2A, the key disadvantage of this scenario is that it does not provide service to DUS.	**CARRY FORWARD**: • Represents a possible phasing strategy to the other full-build scenarios. • While it has the lowest capital cost, it also has the weakest ridership and the lowest OPEX ratio. • Maintains a B/C ratio comparable to the other scenarios. • Provides very strong access to DIA from southeast Denver, Colorado Springs and Pueblo due to the one-seat ride available to these locations. Because it requires a transfer to communities north and west, its ridership is weaker.

[i] Btu estimates from FTA New Starts evaluation criteria [FTA, 2001]). Assume 7% trucks (22,046 Btu/mile), 93% passenger cars (6,233 Btu/mile) = 7340 Btu * VMT. Does not include emissions from rail because technology has not been selected.

[ii] Construction jobs are assumed to be 50 percent of construction costs, with an average salary of $65,000. Construction spin off jobs are calculated based on a multiplier of 2.0. Operations jobs are 50 percent of the operating costs, also at $65,000 salary. Spinoff from operations jobs are calculated using a multiplier of 1.5.

Appendix B:

Level 2 Engineering Report

Level 2 Engineering

1.0 Introduction

This section includes the assumptions, unit price development, and the capital cost estimates developed for the Level 2 scenarios. The Level 2 Conceptual Plan Set on which the cost estimates are based is bound as a separate volume in Appendix B, and includes a Key Plan and segment alignments (described in Level 1) comprising each of the scenarios.

2.0 Assumptions

Scenario Costs

This section presents a comparison of the capital costs of the five finalist scenarios. The cost estimates were based on the alignment drawings shown on the Conceptual Plan Set bound separately in Appendix B. The values provided, are "parametric" estimates, where in the first step, the engineering team develops standard cross sections for at grade track, track on retained fill, track on elevated structure, etc., then in the second step prepares a detailed estimate for each cross section. . These can be defined as dollars per lineal foot, dollars per mile and so forth. In the third step of the process, the estimators determine the number of miles where each of the standard cross is used within a given alignment.

The assumptions the served as the baseline for the estimate are given below, by Federal Railroad Administration Standard Cost Category.

SCC 10: Track and Guideway

The assumptions used for guideway estimating included:

- Double ballasted track was used at all locations with the exception of elevated structures and tunnels in excess of 500'.
- New double track with direct fixation was used for guideway on elevated structures and tunnels in excess of 500'. When direct fixation track is utilized, a 100' transition length on either side of the structure identified as direct fixation with the rest of the approach structure being ballasted track.
- New double track on prepared subgrade was used for retained fill sections.
- New double track on new embankment was used for guideway outside of urban areas.
- In the I-25 North corridor, since the alignment traveled within the median of the highway, the proposed track and guideway was designed to minimize the amount of cut and fill sections and match the existing terrain for a majority of the alignment. The maximum grade allowed was 3.64% for a 0.10 mile segment.
- In the I-25 South corridor, a combination of elevated structures, retained fill, and 5' embankment were utilized. Generally, elevated structures were used in urban areas and retained fill/5' embankment were used in non-urban areas. Elevated structures 30' in height were used to cross over single-level structures such as at-grade roadways. Elevated structures 60' in height were used

to cross over multi-level structures such as an elevated highway crossing over I-25. In non-urban areas with relatively level terrain, 5' embankments were employed. Retained fill was used in non-urban areas with non-level terrain.

- Undergrade structures for railroad over roadway were used for spans up to 300'. Structures longer than 300' were considered elevated structures.
- In the Denver Metro area, opportunities were maximized where an at-grade condition for at least 1,000' could be achieved.
- New double track on cut/fill was used for at grade conditions adjacent to major highway in the Denver Metro area where a bench situation will exist.
- Denver Metro approach structures where assumed to have a 2% grade. For an average 30' high aerial structure, 800' of the approach used retaining walls with 10' average wall height and 700' used retaining walls with 20' average wall height.
- For individual segment quantities and costs, the entire segment is included. When these are rolled up to the scenario level, any shared infrastructure was only carried on one segment. An example of this is between E-470 and DIA; while B-3, B-4 and all E segments utilize the same alignment between E-470 and DIA, the infrastructure was only carried on one segment when combined into a scenario.
- Design speeds where held as high as possible within reason through the Denver Metro area. A balance between speed and impact was used in congested areas. All areas of design speeds in excess of 79 mph were assumed to have no vehicular grade crossings.

SCC 20: Stations, Terminals, Intermodal

The assumptions used for stations and facilities estimating included:

- Two types of station facilities are assumed: Primary Stations and Secondary Stations. Primary stations are located in areas accommodating riders from areas where another station is not easily geographically accessible or highly populated areas accommodating a large service demand. Primary station sites and associated development will require 25 acres of land and will accommodate a 2,000 space parking facility. Secondary stations are located between primary stations and in areas with a smaller service demand. Secondary station sites and associated development will require 10 acres of land.
- Within the I-25 North corridor, a primary station is located in Fort Collins and a secondary station is located in Berthoud. In the I-25 South corridor, primary stations are assumed in Pueblo and Colorado Springs. The Denver Metro area has primary stations at Denver Union Station and Denver International Airport. Note the stations are only carried if the scenario alignments service the area.
- Secondary stations for the I-25 South corridor are located in Castle Rock, Monument, and near Fort Carson. The Denver Metro Area has secondary stations at South Suburban (I-25 and E-470 intersection south of Denver) and North Suburban (I-25 and E-470 intersection north of Denver). In some scenarios an additional secondary station is located at either the Denver Stock Show area or 74^{th} avenue and I-76 to facilitate connections between the north-south and east-west alignments.

SCC 30: Support Facilities: Yards, Shops, Admin. Buildings

The assumptions used for support facilities estimating included:

- Four layover facilities are assumed for each scenario, one each in the north, south, east, and central areas. Specific locations were not identified in Level 2 analyses. Each layover facility will require 5 acres of land.
- One maintenance facility is assumed for each scenario. A specific location was not identified in Level 2 analyses. The maintenance facility will require 40 acres of land.

SCC 40: Sitework, Right of Way, Land, Existing Improvements

The assumptions used for ROW estimating included:

- In rural areas where open drainage can be achieved, a 100' right of way was applied to the entire corridor. In urban areas that are not following a major highway corridor a 60' right of way width was applied to the corridor.
- In areas where the alignment is following a major highway, a 100' right of way width was applied in order to help facilitate realignment of any adjacent roads that might be required.
- The exception to the above is in the I-25 north corridor where the alignment runs in the median of I-25 and no additional right of way will be required. Additionally, portions of the I-25 south corridor will utilize I-25 right of way and no additional land will be needed.

SCC 50: Communications & Signaling

The assumptions for communications and signaling estimating included:

- Automatic Train Control, wayside protection system, and communications with fiber optic backbone are installed over the entire length of each alignment.

SCC 60: Electric Traction

The assumptions for electric traction estimating included:

- Electrification of track will be applied to the entire length of each alignment.

SCC 70: Vehicles

The assumptions for vehicles estimating included:

- Vehicle cost was calculated using the total number of trainsets required by the proposed operating plan. An estimate of 6 cars per trainset plus locomotive was assumed.

SCC 80: Professional Services

The assumptions for Professional Services estimating included:

- Project elements included in the Professional Services category are environmental planning, design engineering, program management, construction management and inspection, engineering services during construction, insurance, and testing and commissioning.

- Professional services and other soft costs required to develop the project have been estimated as a percentage of the estimated construction cost as a separate line item:
  - Design Engineering 10%
  - Insurance and Bonding 2%
  - Program Management 4%
  - Construction Management and Inspection 6%
  - Engineering Services During Construction 2%
  - Integrated Testing and Commissioning 2%
- Total Professional Services cost of 26% of the total construction cost was applied.

SCC 90: Unallocated Contingency

The assumptions for contingency costs included:

- Contingency costs were added as an overall percentage of the total construction cost.
- Contingencies are an allowance added to the estimate of costs to account for items and conditions that cannot be realistically anticipated.
- An overall design and construction contingency of 30% of the total construction cost was applied.
- Unallocated contingency also includes reserves for utility relocation. Utility relocation costs were calculated as a percentage of the total construction cost for urban and non-urban relocation. Urban relocation is 6% of the total construction cost and non-urban relocation is 3% of the total construction cost.
- Environmental mitigation is also considered a contingency cost. Environmental mitigation have been estimated as a percentage of the construction cost:
  - Noise Mitigation 1%
  - Hazardous Waste 1%
  - Erosion Control 0.5%

SCC 100: Finance Charges

Finance charges for the project were not calculated in Level 2.

3.0 Description of Unit Cost Items

A description of the unit cost items used for the scenario cost estimates is attached hereto as a Technical Report.

4.0 Level 2 Cost Estimates

The Level 2 Cost Estimates are attached hereto with a Summary page and detailed spreadsheets representing each of the finalist scenarios and associated variants (i.e., via US 6 or I-76).

Technical Report: Description of Unit Cost Items for the Denver Interregional Connectivity Study

May 2013

Introduction

Unit cost items and associated unit costs are identified in the Capital Cost Methodology for Denver Interregional Connectivity Study. The following Technical Report describes each unit cost item and the major cost elements included in the unit cost item. Using the unit costs and quantities developed in the planning phase, capital cost estimates were calculated for each Denver ICS Scenario.

Typical sections provided in this report are sourced from the California High Speed Train Program's Technical Memorandum 1.1.21 on Typical Cross Sections for 15% Design and the Midwest Regional Rail Initiative's Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way.

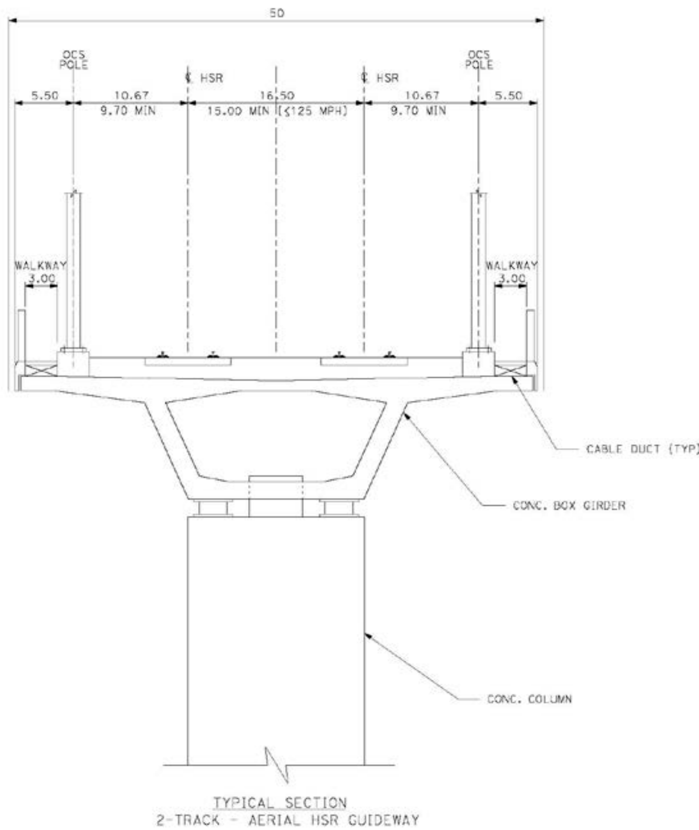
Steel Wheel/Steel Rail on Greenfield Alignments

10 Track Structures and Track

10.01 Track Structure: Viaduct

10.01.01 – Elevated Structure – 2 Track (30' Avg. Pier Ht)
10.01.02 – Elevated Structure – 2 Track (60' Avg. Pier Ht)
10.01.03 – Elevated Structure Straddle – 2 Track (30' Ave. Pier Ht)

- Typical track section for elevated structures is displayed below. Structures 30' in height were deemed necessary through all urban areas and for crossing over at-grade roadways, railroads, rivers, and other immobile objects and terrain running semi-parallel to the alignment. Structures 60' in height are assumed only in areas in which the alignment must pass over elevated structures for existing roadways and railroads. Another type of elevated structure, straddle structures, are assumed when entering a highway median from outside the highway right-of-way and when crossing over a major interstate highway. The unit cost for elevated structures does not include cost for track.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.03 Track Structure: Undergrade Bridges

10.03.01 – Undergrade Bridge (Double Track)

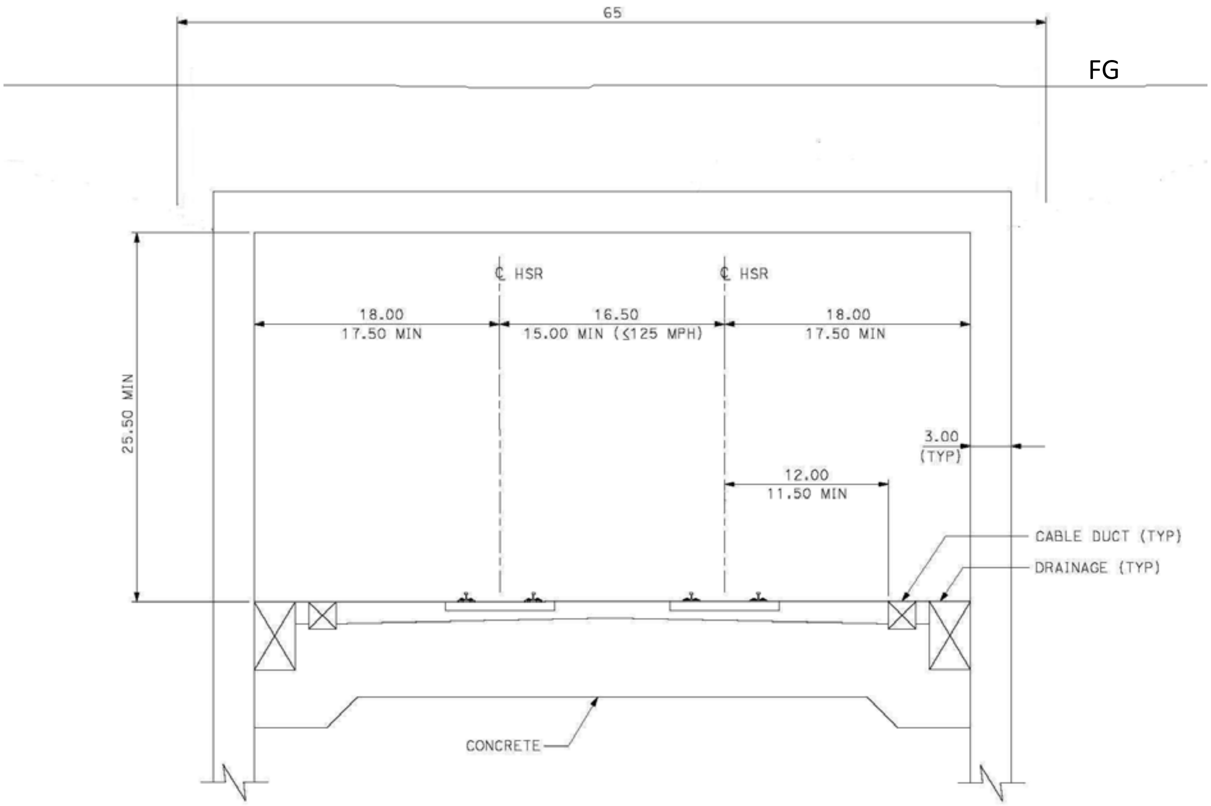
Roadways, railroads, and rivers that the alignment crosses perpendicularly are addressed with an undergrade bridge structure. An exhibit is shown below. The unit cost associated with an undergrade bridge includes a provision for new abutments, necessary grading and earth retention system to control the embankment at the abutments, new piers, and the placement of a new 200' long and 44' wide superstructure at undergrade bridge locations. The unit cost for undergrade bridges does not include cost for track.

Source: Reinforced Earth Company

10.07 Track Structure: Tunnel

10.07.01 – Cut & Cover Box – 2 Track/1 Box (40' Avg. Exc. Depth)

- A typical cross section for Cut & Cover Box Tunnel is shown below.. Tunnels are used in the Denver Metro area in locations where the HSR tracks cross highways on embankments. In these situations, it is more cost effective to tunnel under the highway than bridge over it. No tunnels are present in the I-25 north and south alignments. The unit costs associated with this typical section include excavation and concrete tunnel.. The unit cost for cut & cover box does not include cost for track.

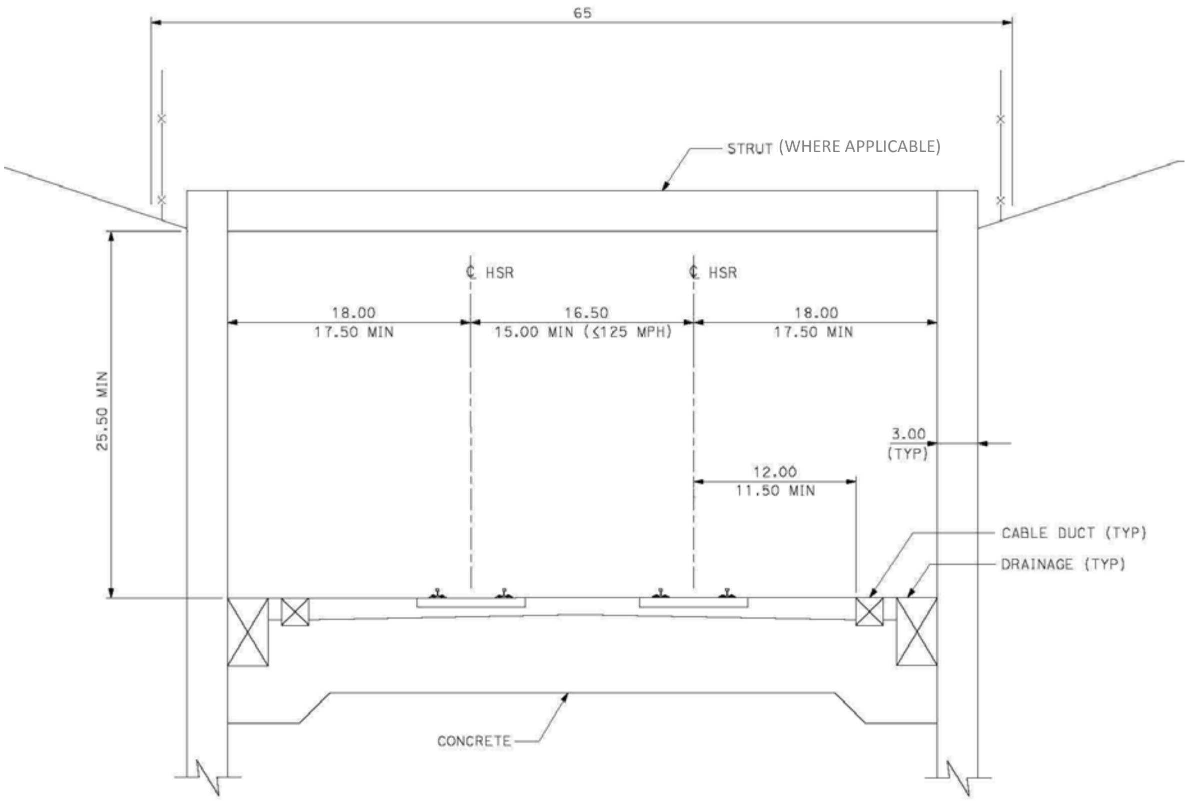


Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.08 Track Structure: Retaining Walls and Systems

10.08.01 – Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)
10.08.02 - Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)

- Typical cross sections for retained cut and trench are displayed below. The unit cost associated with these typical cross sections includes excavation and removal of dirt and the cost of retaining walls. The unit cost for retained cut does not include cost for track.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.08.03 - Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)
10.08.04 - Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)
10.08.05 - Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)

- An exhibit showing a retained fill section is displayed below. Retained fill is required in urban and rural areas for elevated structure approaches and is assumed to have an average height of 20' for 1500'. The unit cost associated with this retained fill typical section includes cost for retaining walls and appropriate amounts of fill and subgrade needed for track construction. The unit cost for retained fill does not include cost for track.

Source: Reinforced Earth Company

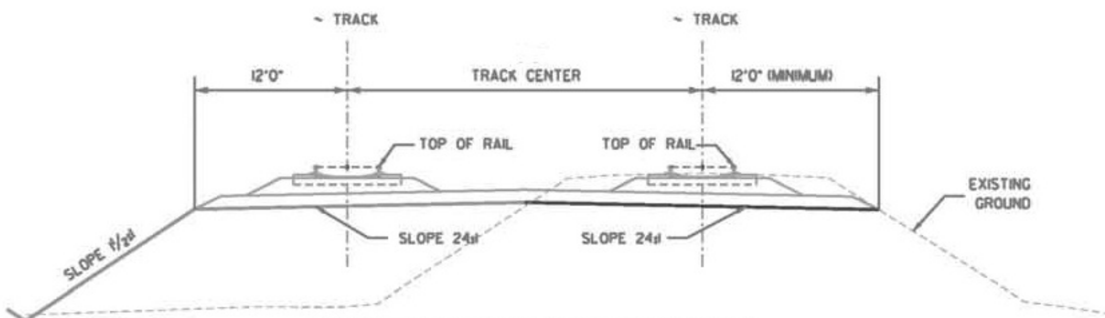
10.09 Track New Construction: Conventional Ballasted

10.09.01 - Double Track New Construction on New Embankment

- A typical section of new track construction on new embankment is shown below. The unit cost associated with this typical section includes costs for construction of a 5' embankment, ballast, ties, and a double track. This item is assumed where new sections of track are constructed in the vicinity of existing passenger/freight track. Where the new track is adjacent to existing track, a retained fill section may be necessary.

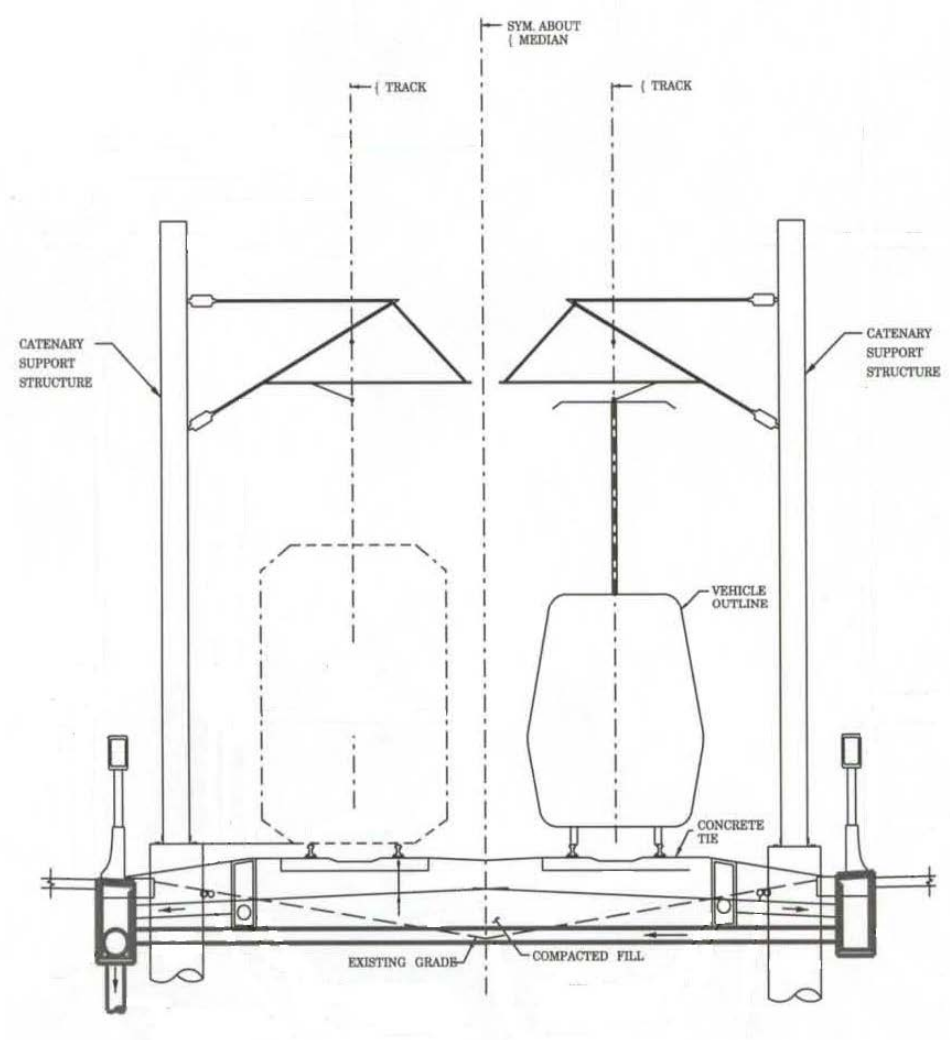
10.09.02 - Double Track New Construction on Prepared Subgrade

- Typical cross sections for this item are shown below. The unit cost associated with double track new construction on prepared subgrade includes ballast, ties, and a double track. This unit cost does not include costs for a 5' embankment. It is assumed that this type of track construction will occur in locations where a subgrade has already been prepared, such as on a retained cut or fill section.



DOUBLE TRACK "FILL" SECTION

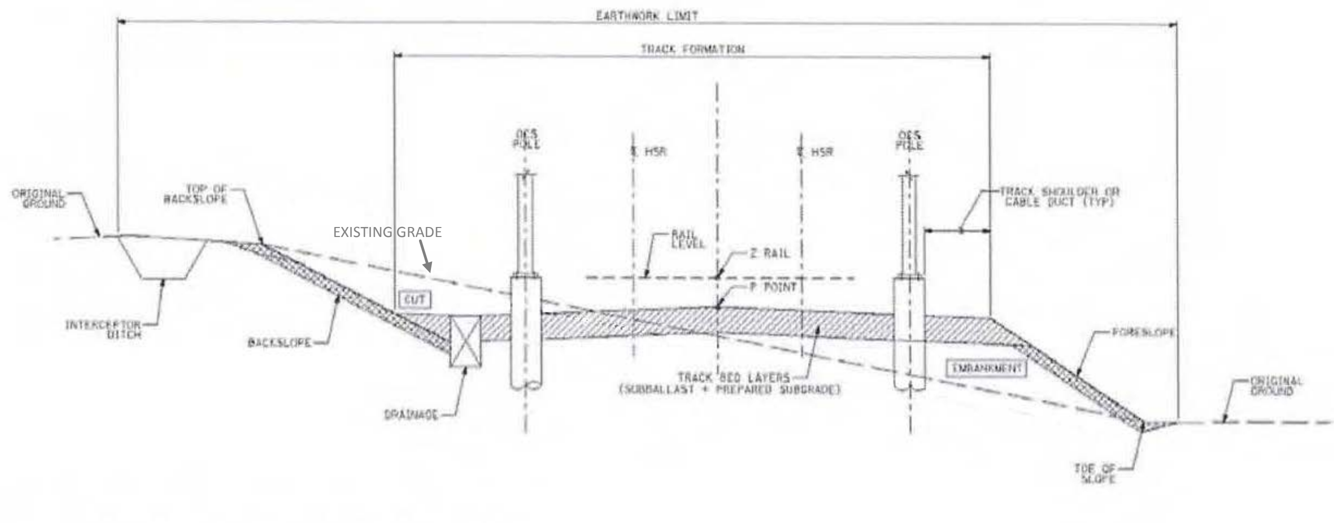
Source: Midwest Regional Rail Initiative - Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way



Source: Tampa to Miami Feasibility Study, Florida HSRA, March 2003

10.09.03 - Double Track New Construction on Cut/Fill Section (retaining walls as needed)

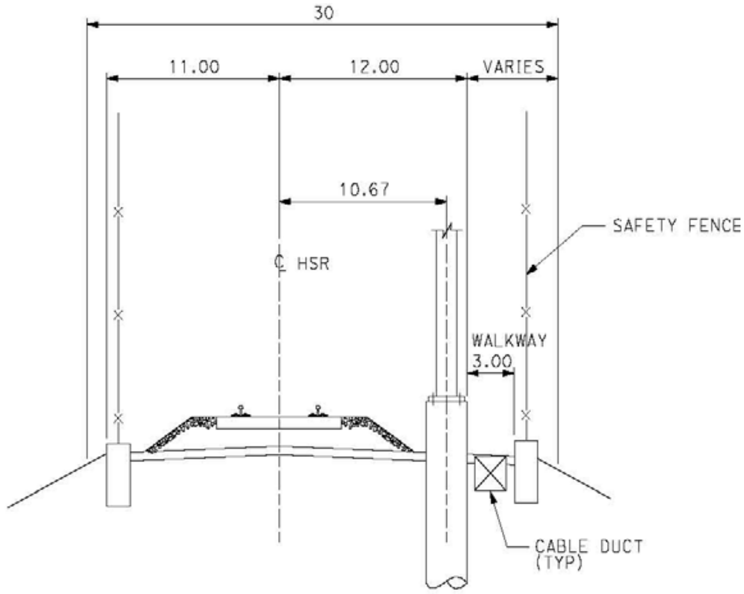
- The typical cross section for this item of work is shown below. The unit cost associated with new track construction on cut or fill sections include earthwork costs, retaining walls (if needed), ballast, ties, and a double track. This type of track construction is assumed for sections of track that will be constructed adjacent to highway embankments or other areas that are not level ground and not adjacent to existing passenger/freight track.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.09.04 - Single Track New Construction on Prepared Subgrade

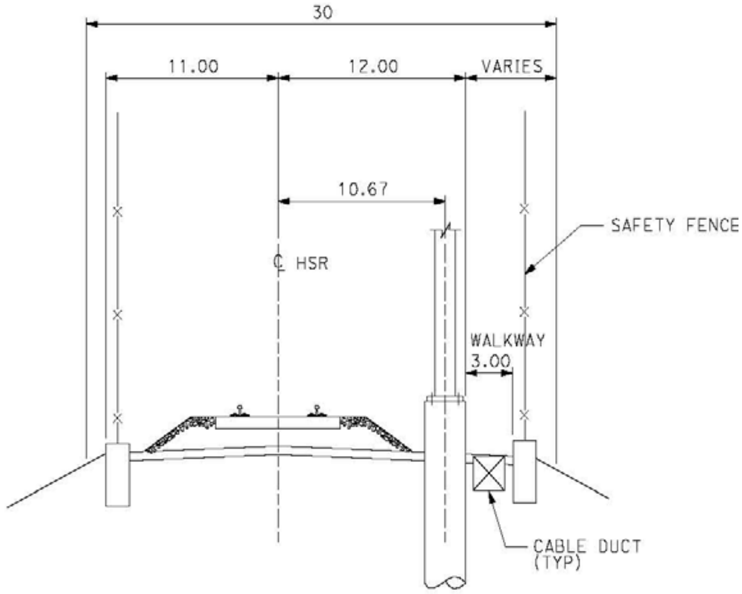
- Costs for single track new construction on prepared subgrade include ballast, ties, and a single track. This item does not include costs for a 5' embankment. It is assumed that this type of track construction will occur in locations where a subgrade has already been prepared, such as on a retained cut or fill section.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.09.05 - Single Track New Construction on New Embankment

- New embankment is assumed to include costs for construction of a 5 foot embankment, ballast, ties, and a single track. This item is assumed where new sections of track are located adjacent to existing passenger/freight track.

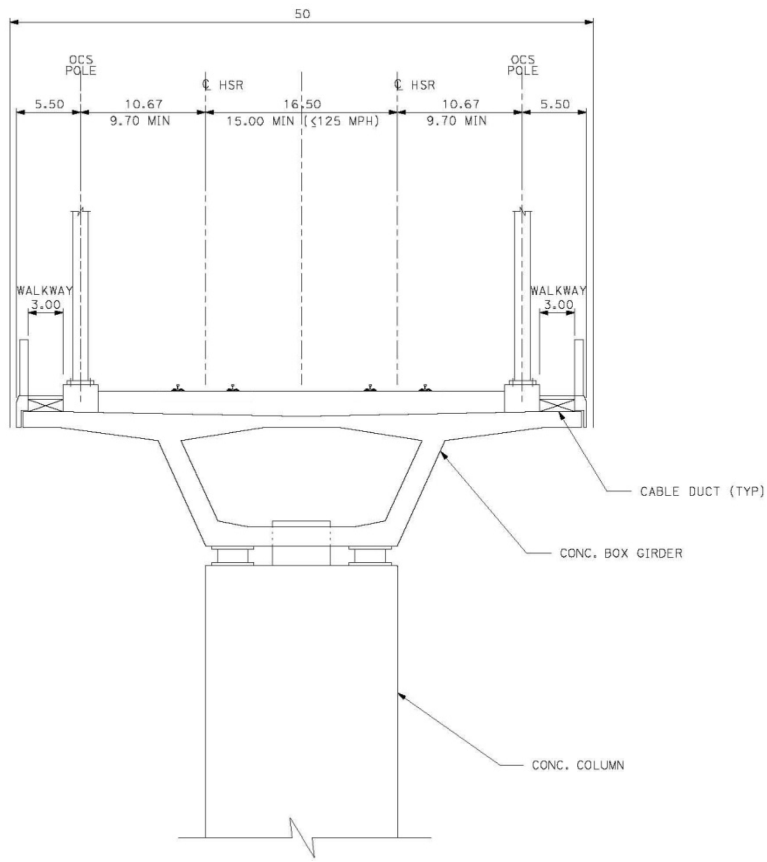


Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

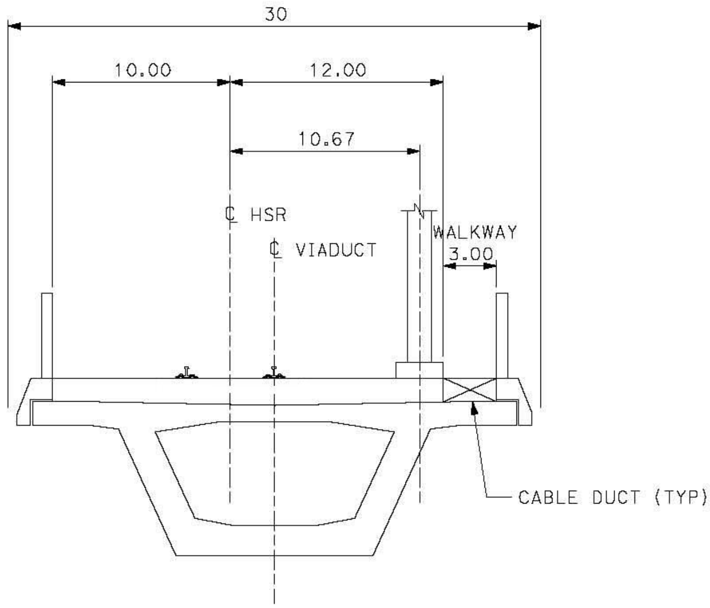
10.10 Track New Construction: Non-Ballasted

10.10.01 - Double Track New Construction with Direct Fixation
10.10.02 – Single Track New Construction with Direct Fixation

- Direct fixation of track occurs on all elevated structures. A typical cross section is shown below. The unit cost for this item includes track and other materials to anchor the track to the structure. The cost of the structure itself is not included.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

<u>10.18 Other Linear Structures Including Fencing, Sound Walls</u>

10.18.01 – Highway Barrier Type 6

- These barriers are only included where the alignment runs inside a highway median at or below grade and a horizontal curve exists. The unit cost for this item of work includes the complete installation of the item. Highway Barrier Type 6 are reinforced concrete barriers meeting the requirements of NCHRP Report 350 Test Level 6.

Source: *Roadside Design Guide 2002,* American Association of state Highway and Transportation Officials, Washington, D.C. Used by permission. Documents may be purchased from the AASHTO bookstore at 1-800-231-3475 or https://bookstore.transportation.org

10.18.02 – Highway Barrier Type 5

- These barriers are only included where the alignment runs inside a highway median at or below grade and on tangent track. The unit cost for this item of work includes the complete installation of the item. Highway Barrier Type 5 are reinforced concrete barriers meeting the requirements of NCHRP Report 350 Test Level 5.

Source: *A Guide to Standardized Highway Barrier Hardware, Online Hardware Guide*, AASHTO-AGS-ARTBA Joint Committee, Subcommittee on New Highway Materials, Task Force 13 Report - http://aashtotf13.tamu.edu/Guide/nameindex.html

10.18.03 – Fencing, 10 ft Chain Link (both sides)

- Fencing will be installed on top of high way barriers when present (type 5 and 6). The unit cost for this item includes the cost of a 10’ chain link fence and installation of the fence. Fencing will be installed on both sides of the track.

10.18.04 – Fencing, 6 ft Chain Link (both sides)

- 6’ fencing will be installed in rural areas along alignments that use existing rail right-of-way. The unit cost for this item includes the cost of a 6’ chain link fence and installation of the fence.

10.18.05 – Decorative Fencing (both sides)

- Decorative fencing will be installed in urban areas along alignments that use existing rail right-of-way. The unit cost for this item includes the cost of the decorative fencing and the installation of the fence.

20 Stations, Terminals, Intermodal

20.01 – Primary station buildings: Intercity passenger rail only

- Primary stations are located in areas accommodating riders from areas where another station is not easily geographically accessible or highly populated areas accommodating a large service demand. These stations are assumed in Fort Collins, Denver Union Station, Denver International Airport, North, West, and South Suburban Stations, Colorado Springs, and Pueblo. The unit cost for this item includes the station building and platform, drainage, grading, lighting, landscaping, signage, security, site furnishings, 2,000 space parking facility, vehicle access and circulation, bicycle facilities, and access to other modes of public transit. It is assumed that primary station sites and associated development will require 25 acres of land.

20.02 – Secondary station buildings: Intercity passenger rail only

- Secondary stations are located between primary station locations and in areas with a smaller service demand. These will be used mainly as transfer stations. These stations are assumed at I-76/72nd Avenue and in Berthoud, Castle Rock, Monument, and near Fort Carson. The unit cost for this item includes the station building and platform, drainage, grading, lighting, landscaping, signage, security, site furnishings, bicycle facilities, and access to other modes of public transit. It is assumed that secondary station sites and associated development will require 10 acres of land.

30 Support Facilities: Yards, Shops, Admin. Buildings

<u>30.02 Light Maintenance Facility</u>

30.02.01 – Layover Facility

- Four layover facilities are assumed for the ICS, one each in the general north, south, east, and central areas of the system. Specific locations were not identified in Level 2 analyses. A layover facility has the capability of providing daily servicing and inspection and will provide cleaning and replenishing of provisions for the daily service requirements. It is assumed that the layover facitilies will each require 5 acres of land. Additionally, electrical hookups, waste disposal, and potable water facilities are needed to service the passenger coaches.[1]

<u>30.03 Heavy Maintenance Facility</u>

30.03.01 – Maintenance Facility (electrified track)

- One maintenance facility is assumed for each scenario. Specific locations were not identified in Level 2 analyses. A maintenance facility will house daily servicing and inspection facilities, preventive maintenance and corrective maintenance shops for coaches and locomotives, material storage, health and welfare facilities, and a storage yard. If the maintenance facility is a hub facility, it may also support heavy repair and high-level

[1] Midwest Regional Rail Initiative Phase 7 – Technical Report: Operating Equipment Configurations and Performance Standards - LTK Engineering Services, 2010

preventive maintenance work for the entire ICS fleet.[2] It is assumed that a facility will require 40 acres of land.

40 Sitework, Right of Way, Land, Existing Improvements

40.05 Site Structures Including Retaining Walls, Sound Walls

40.05.01 – Highway Bridge Over High Speed Rail

- Overhead highway bridges were assumed to be reconstructed at all locations where the railroad alignment travels under existing highway bridges. Bridges are assumed to span over 2 railroad tracks and have the width of an average 4 lane roadway structure. Work includes reconstruction of the existing overhead structure to accommodate the new railroad tracks. The unit cost associated with this item of work includes construction of a new abutment, necessary grading and earth retention system to control the embankment at the abutments, new piers, and the placement of a new highway bridge is included.

40.07 Purchase or Lease of Real Estate

40.07.01 – Land Acquisition Rural

- The amount of land acquisition required is calculated assuming that rail acquisition will require a 100’ width of right of way. Land acquisition is assumed to be rural in areas outside of large population areas such as Fort Collins, Denver, Castle Rock, Monument, Colorado Springs, and Pueblo. The portions of the alignment that run closely to I-25 are considered to be on CDOT property and do not require acquisition costs. On the I-25 South alignment, 50% of the alignment adjacent to I-25 will be considered on CDOT property. North of Denver, a small portion of land between E-470 and the location where the alignment enters the I-25 median is considered rural. No land acquisition within the Denver area is considered rural.

- The unit cost for rural land acquisition includes the purchase of land and/or easement rights, relocation assistance, and demolition costs.

40.07.02 – Land Acquisition Urban

- Urban land acquisition is calculated assuming that rail acquisition will require a 60’ width of right of way, except in areas where the alignment is being constructed adjacent to an existing railroad. A 100 ft right of way is assumed at these locations. The portions of the alignment that are located in the highway median are assumed to be CDOT property and do not require acquisition costs. All property within the Denver area is considered to be urban. Urban areas on the I-25 south alignment include the short segment between highway E-470 and Lincoln Avenue and the cities of Castle Rock, Monument, Colorado Springs, and Pueblo. City limits for this item begin and end where residential property becomes noticeably dense.

[2] Midwest Regional Rail Initiative Phase 7 – Technical Report: Operating Equipment Configurations and Performance Standards - LTK Engineering Services, 2010

- The unit cost for urban land acquisition includes the purchase of land and/or easement rights, relocation assistance, and demolition costs.

40.07.03 – Relocation – Commercial
40.07.04 – Relocation – Residential

- Relocation may be necessary, but quantities were not calculated for Level 2 analyses.

50 Communications & Signaling

50.01 Wayside Signaling

50.01.01 - Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone

- These items included Automatic Train Control (ATC), Wayside Protection System, and Communications (w/Fiber Optic Backbone). This item is assumed for double tracks installed over the entire length of the corridor. The unit cost for train control includes the wayside, on-board, and central control software and hardware for the overall signaling system. The unit cost for the Wayside Protection System includes systems/equipment to monitor and/or detect obstacles that may be placed or fall onto the track, intrusion, flooding, wind, seismic activity, and equipment failures. The unit cost for a fiber optic backbone includes systems/equipment to operate a communication system along the corridor.[3]

50.04 Grade Crossing Protection

50.04.01 – Crossing Closure
- This work consists of completely removing the crossing surface and roadway approaches that lead across the tracks within railroad right of way. If there are any warning devices, those will be removed as well. The unit cost of the item includes modest improvements such as barricades/roadway closure treatments and alternate connection to an existing roadway.

[3] California High-Speed Train Program EIR/EIS – Capital Cost: Definition of Cost Elements

50.04.02 – Four Quadrant Gates w/ Trapped Vehicle Detector

- The work consists of installing a warning system consisting of mechanical, visual, and audible devices where a roadway crosses a railroad at grade. The four quadrant gate with vehicle presence detection system includes all hardware, software, wiring, communication equipment, and commercial power with battery backup to operate the warning system. A power drop is required at each at-grade crossing. The unit cost includes all hardware, software, wiring, communication equipment, commercial power, four quadrant gate equipment, and appropriate pavement markings and warning signage. An exhibit of an intersection with four quadrant gates is shown below.

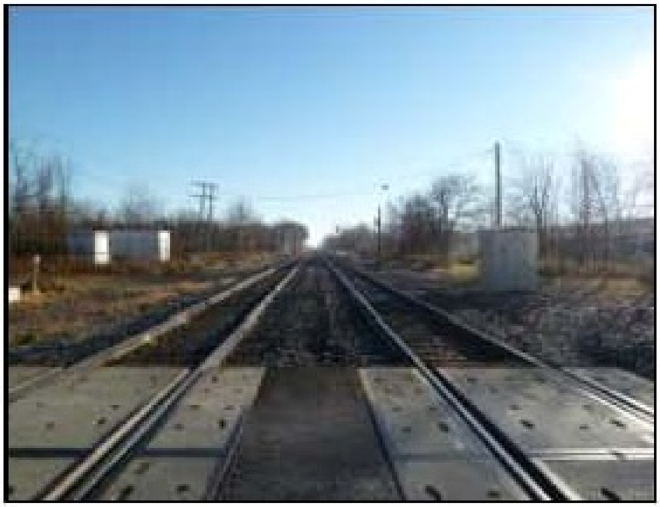
Source: Volpe Center photo; Four quadrant gates at the School street crossing on the Northeast Corridor High Speed Rail Line in Mystic, Ct

50.04.03 – Precast panels with Roadway Improvements

- The unit cost for this item includes installing prefabricated concrete and steel crossing surface panels at a grade crossing. The crossing panels are placed within the track structure at the crossing to form a smooth running surface for vehicular traffic. The top surface of the panel will be level with the top of rail. The width of the crossing treatment will include and extend beyond associated sidewalks if present. At a minimum, the crossing panels will extend 2’ beyond the paved roadway surface or sidewalk.

- Roadway crown and superelevation in the approach pavement will be eliminated at or tapered into the crossing to match the grade and profile of the track. Additionally, the elevation of the approach pavement will be reconstructed to equal the top of rail for a minimum of 2’ beyond the outer rail of the outermost track in each direction. Finally, the roadway surface must be within +/- 3” of the top of rail at a distance of 30’ from the outermost rail, unless track superelevation dictates otherwise.

- Exhibit of precast panels is shown below.



Source: Midwest Regional Rail Initiative - Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way

60 Electric Traction

60.02.01- Traction Power Supply

- The unit cost for Traction Power Supply includes the cost of the substations including site preparation, foundations, cable trenches, fencing, and electrical equipment. It does not include the cost of transmission lines from the local utility source to the substations. Those costs are included in operating and maintenance costs as "energy costs".[4]

- The unit cost for this item is applied per route mile of track.

60.03.01- Traction Power Distribution Catenary

- The unit cost for Traction Power Distribution includes the cost of the catenary poles and foundations, catenary wires and supports, tensioning devices, power feeders and returns, transformers, and other appurtenances.[5]

- The unit cost for this item is applied per route mile of track..

[4] California High-Speed Train Program EIR/EIS – Capital Cost: Definition of Cost Elements
[5] California High-Speed Train Program EIR/EIS – Capital Cost: Definition of Cost Elements

ICS: Denver Metro Capital Cost Estimate

Level 2 Scenerio Costs

ICS Unit Costs for Steel Wheel/Steel Rail

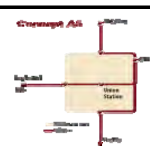
SCENARIO

(COSTS IN THOUSANDS)			
Category	**A6 (6th ave)**	**A6-D1 (I-70)**	**A6-D2 (I-76)**
TOTAL MILES	292.92	303.84	303.64
10 TRACK STRUCTURES & TRACK	$ 7,253,303.20	$ 7,638,688.19	$ 7,447,638.21
20 STATIONS, TERMINALS, INTERMODAL	$ 400,000.00	$ 425,000.00	$ 425,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$ 243,048.00	$ 243,048.00	$ 243,048.00
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$ 1,395,237.53	$ 1,552,637.94	$ 1,528,456.54
50 COMMUNICATIONS & SIGNALING	$ 629,749.09	$ 653,226.03	$ 652,796.03
60 ELECTRIC TRACTION	$ 1,523,114.08	$ 1,579,895.52	$ 1,578,855.52
PROFESSIONAL SERVICES	$ 2,918,335.23	$ 3,083,586.40	$ 3,028,327.55
UTILITY RELOCATION	$ 507,206.84	$ 549,618.67	$ 535,138.09
ENVIRONMENTAL MITIGATION	$ 286,111.30	$ 302,312.39	$ 296,894.86
CONTINGENCY	$ 4,546,831.58	$ 4,808,403.94	$ 4,720,846.44
TOTAL SCENARIO COST	**$ 19,702,936.86**	**$ 20,836,417.09**	**$ 20,457,001.24**
COST/MILE	*$ 67,264.68*	*$ 68,577.83*	*$ 67,373.42*

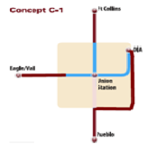
SCENARIO

(COSTS IN THOUSANDS)			
Category	**Scenario A1 - US 6**	**Scenario A1 - I-76**	**Scenario A5 - US 6**
TOTAL MILES	208.63	219.35	215.42
10 TRACK STRUCTURES & TRACK	$ 5,326,576.40	$ 5,519,667.47	$ 5,141,407.06
20 STATIONS, TERMINALS, INTERMODAL	$ 400,000.00	$ 425,000.00	$ 400,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$ 243,048.00	$ 243,048.00	$ 243,048.00
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$ 1,018,332.48	$ 1,151,551.49	$ 939,232.55
50 COMMUNICATIONS & SIGNALING	$ 429,038.36	$ 452,085.30	$ 463,131.50
60 ELECTRIC TRACTION	$ 1,037,674.18	$ 1,093,415.62	$ 1,120,132.00
PROFESSIONAL SERVICES	$ 2,155,940.70	$ 2,265,615.81	$ 2,118,272.53
UTILITY RELOCATION	$ 398,169.04	$ 426,347.66	$ 373,975.45
ENVIRONMENTAL MITIGATION	$ 211,366.74	$ 222,119.20	$ 207,673.78
CONTINGENCY	$ 3,366,043.77	$ 3,539,655.17	$ 3,302,061.86
TOTAL SCENARIO COST	**$ 14,586,189.68**	**$ 15,338,505.72**	**$ 14,308,934.74**
COST/MILE	*$ 69,913.24*	*$ 69,926.37*	*$ 66,423.43*

SCENARIO

(COSTS IN THOUSANDS)			
Category	**Scenario A5 - I-76**	**Scenario B2A**	**B5**
TOTAL MILES	214.67	208.40	215.51
10 TRACK STRUCTURES & TRACK	$ 5,036,768.66	$ 4,918,755.00	$ 5,028,948.79
20 STATIONS, TERMINALS, INTERMODAL	$ 375,000.00	$ 350,000.00	$ 375,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$ 243,048.00	$ 243,048.00	$ 243,048.00
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$ 965,121.92	$ 740,776.78	$ 876,376.16
50 COMMUNICATIONS & SIGNALING	$ 461,519.00	$ 448,038.50	$ 463,260.50
60 ELECTRIC TRACTION	$ 1,116,232.00	$ 1,083,628.00	$ 1,120,444.00
PROFESSIONAL SERVICES	$ 2,090,410.84	$ 1,083,628.00	$ 2,067,304.75
UTILITY RELOCATION	$ 373,106.88	$ 1,984,982.80	$ 349,571.98
ENVIRONMENTAL MITIGATION	$ 204,942.24	$ 341,563.05	$ 202,676.94
CONTINGENCY	$ 3,259,844.86	$ 3,091,619.49	$ 3,217,989.33
TOTAL SCENARIO COST	**$ 14,125,994.41**	**$ 13,397,017.78**	**$ 13,944,620.44**
COST/MILE	*$ 65,803.30*	*$ 64,285.11*	*$ 64,705.21*

SCENARIO



(COSTS IN THOUSANDS)

Category	C1	
TOTAL MILES		172.64
10 TRACK STRUCTURES & TRACK	$	4,099,736.96
20 STATIONS, TERMINALS, INTERMODAL	$	325,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$	243,048.00
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$	736,301.58
50 COMMUNICATIONS & SIGNALING	$	371,154.50
60 ELECTRIC TRACTION	$	897,676.00
PROFESSIONAL SERVICES	$	1,701,593.85
UTILITY RELOCATION	$	304,002.43
ENVIRONMENTAL MITIGATION	$	166,822.93
CONTINGENCY	$	2,653,600.87
TOTAL SCENARIO COST	**$**	**11,498,937.11**
COST/MILE	*$*	*66,606.45*

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A1 - I-76

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment NS-1		Segment NS-2	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		E470/I-76 to DUS		DUS to C470/US-85	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		24.7 miles		24.2 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.83	$ 264,726.70	1.52	$ 83,051.52	3.07	$ 168,179.32	11.97	$ 656,106.97
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.11	$ 8,331.82	0.19	$ 13,886.36	0.21	$ 15,275.00	1.04	$ 76,375.00
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.49	$ 41,276.97	-	$ -	-	$ -	1.12	$ 93,666.97
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	14.00	$ 39,312.00	1.00	$ 2,808.00	12.00	$ 33,696.00	4.00	$ 11,232.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	-	$ -	0.27	$ 39,037.20	0.30	$ 44,613.94	-	$ -
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	0.27	$ 10,341.44	-	$ -
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25	0.21	$ 19,857.29	-	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	2.03	$ 19,726.10	1.50	$ 14,564.13	3.22	$ 31,340.53	2.31	$ 22,491.44
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	1.36	$ 36,846.82	1.31	$ 35,311.53	2.25	$ 60,899.60	2.61	$ 70,623.07
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.27	$ 12,458.14	0.30	$ 14,237.88	0.19	$ 8,898.67	0.27	$ 12,458.14
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	3.71	$ 11,964.17	3.49	$ 11,237.77	6.90	$ 22,242.97	5.11	$ 16,481.25
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	9.41	$ 35,544.79	12.50	$ 47,237.50	1.53	$ 5,797.33
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	8.45	$ 42,234.848	2.61	$ 13,068.182	1.86	$ 9,280.303	3.20	$ 16,003.788
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.92	$ 22,363.38	2.22	$ 8,373.92	3.47	$ 13,097.67	14.31	$ 54,075.49
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	18.08	$ 4,000.20	17.72	$ 3,920.55	24.74	$ 5,474.22	15.09	$ 3,338.66
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 503,241.15**	-	**$ 296,214.52**		**$ 490,434.46**		**$ 1,038,650.11**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	-	$ -	1.00	$ 25,000.000	1.00	$ 25,000.000	1.00	$ 25,000.000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ -		$ 75,000.00		$ 75,000.00		$ 25,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	9.00	$ 43,056.00	6.00	$ 28,704.00	2.00	$ 9,568.00	5.00	$ 23,920.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	375,587.20	$ 4,131.46	3,391,132.80	$ 37,302.46	2,667,456.00	$ 29,342.02	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	7,136,156.80	$ 156,995.45	2,774,563.20	$ 61,040.39	2,667,456.00	$ 58,684.03	8,329,888.00	$ 183,257.54
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 204,182.91**		**$ 127,046.85**		**$ 97,594.05**		**$ 207,177.54**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	18.08	$ 38,872.00	17.72	$ 38,098.00	24.74	$ 53,195.80	15.09	$ 32,443.50
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 38,872.00**		**$ 38,098.00**		**$ 53,195.80**		**$ 32,443.50**
60 ELECTRIC TRACTION															
60.02	**Traction power supply: Substations**														

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A1 - I-76

Monday, June 24, 2013

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment NS-1		Segment NS-2	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		E470/I-76 to DUS		DUS to C470/US-85	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		24.7 miles		24.2 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	18.08	$ 50,624.00	17.72	$ 49,616.00	24.74	$ 69,278.26	15.09	$ 42,252.00
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	18.08	$ 43,392.00	17.72	$ 42,528.00	24.74	$ 59,381.36	15.09	$ 36,216.00
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 94,016.00**		**$ 92,144.00**		**$ 128,659.62**		**$ 78,468.00**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 978,556.34**		**$ 3,978,229.04**		**$ 840,312.05**		**$ 628,503.37**		**$ 844,883.94**		**$ 1,381,739.14**
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 214,279.57**		**$ 160,268.36**		**$ 215,445.40**		**$ 352,343.48**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		45%		34%		100%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		55%		66%		0%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	17.18	$ 47,897.79	7.97	$ 16,969.59	8.42	$ 17,251.29	24.16	$ 82,904.35
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.90	$ 1,260.47	9.75	$ 10,370.31	16.32	$ 16,720.88	-	$ -
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 49,158.26**	-	**$ 27,339.90**		**$ 33,972.16**		**$ 82,904.35**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 21,007.80**		**$ 15,712.58**		**$ 21,122.10**		**$ 34,543.48**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 337,427.306		$ 249,547.262		$ 334,627.079		$ 555,459.135
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**		**$ 1,462,184.99**		**$ 1,081,371.47**		**$ 1,450,050.68**		**$ 2,406,989.59**
	cost/mile (2013)			$	42,184.52	$	72,475.15	$	80,873.06	$	61,025.48	$	58,606.29	$	99,627.05

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470/Brush Line to the north suburban station was ADDED to NS-1

2 DIA station carried in E-5

3 North Suburban station carried in NS-1

4 South Suburban station carried in NS-2

5 DUS carried in NS-1

6 Golden station not included - is part of AGS Study

7 74th ave station carried on E-5

See notes at bottom of page			Segment No.	Scenerio A1-A Total
ICS: Denver Metro Capital Cost Estimate			From - To	
Scenario A1 - I-76			Host Carrier	
Monday, June 24, 2013			Mileposts	
			Track Miles	219.4 miles

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount
10 TRACK STRUCTURES & TRACK					
10.01	**Track structure: Viaduct**				
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	**44.93**	$ 2,462,934
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	**4.38**	$ 321,364
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	**2.56**	$ 214,577
10.03	**Track structure: Undergrade Bridges**				
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	**131.00**	$ 367,848
10.07	**Track structure: Tunnel**				
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	**0.57**	$ 83,651
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	**-**	$ -
10.08	**Track structure: Retaining walls and systems**				
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	**1.04**	$ 40,574
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	**0.32**	$ 30,689
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	**14.43**	$ 140,491
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	**30.75**	$ 830,838
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	**1.02**	$ 48,053
10.09	**Track new construction: Conventional ballasted**				
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	**48.31**	$ 155,715
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	**58.59**	$ 221,411
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	**55.41**	$ 277,037
10.10	**Track new construction: Non-ballasted**				
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	**57.01**	$ 215,437
10.18	**Other linear structures including fencing, sound walls**				
10.18.01	Highway Barrier Type 6	LF	$ 1.43	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	**113.28**	$ 25,064
	Sub-total Track Structures & Track (A)				**$ 5,519,667**
20 STATIONS, TERMINALS, INTERMODAL					
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	**5.00**	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	**7.00**	$ 175,000
	Sub-total Stations, Terminals, Intermodal (B)				**$ 425,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS					
30.02	**Light maintenance facility**				
30.02.01	Layover Facility	EA	$ 10,504	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**				
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	**1.00**	$ 201,032
30.05	**Yard and yard track**				
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS					
40.05	**Site structures including retaining walls, sound walls**				
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	**43.00**	$ 205,712
40.07	**Purchase or lease of real estate**				
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	**24,365,056.00**	$ 268,016
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	**30,810,176.00**	$ 677,824
40.07.03	Relocation - Commercial	EA		**-**	$ -
40.07.04	Relocation - Residential	EA		**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 1,151,551**
50 COMMUNICATIONS & SIGNALING					
50.01	**Wayside signaling equipment**				
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	**210.27**	$ 452,085
	Sub-total Communications & Signaling (E)				**$ 452,085**
60 ELECTRIC TRACTION					
60.02	**Traction power supply: Substations**				

See notes at bottom of page			Segment No.	Scenerio A1-A Total
ICS: Denver Metro Capital Cost Estimate			From - To	
Scenario A1 - I-76			Host Carrier	
Monday, June 24, 2013			Mileposts	
			Track Miles	219.4 miles

FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	Quantity	Amount
60.02.01	Traction Power Supply	Route Mile	$ 2,800	**210.27**	$ 588,762
60.03	**Traction power distribution: Catenary and third rail**				
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	**210.27**	$ 504,653
	Sub-total Electric Traction (F)				**$ 1,093,416**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 8,884,768**
PROFESSIONAL SERVICES					
	Design Engineering	10%			
	Insurance and Bonding	2%			
	Program Management	4%			
	Construction Management & Inspection	6%			
	Engineering Services During Construction	2%			
	Integrated Testing and Commissioning	2%			
	Sub-total Professional Services (G)		26%		**$ 2,265,616**
UTILITY RELOCATION					
	Percentage of Route that is in Urban Areas			**60%**	
	Percentage of Route that is Outside of Urban Areas			**40%**	
	Through Urban Areas	6%	6%	**131.54**	$ 319,682
	Outside of Urban Areas	3%	3%	**87.78**	$ 106,666
	Sub-total Utility Relocation (H)				**$ 426,348**
ENVIRONMENTAL MITIGATION					
	Noise Mitigation	1%			
	Hazardous Waste	1%			
	Erosion Control	0.5%			
	Sub-total Environmental Mitigation (I)		2.5%		**$ 222,119**
CONTINGENCY					
	Design and Construction Contingency		30%		**$ 3,539,655**
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 15,338,506**
	cost/mile (2013)			$ 69,926.37	

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470/Brush Line to the north suburban station was ADDED to NS-1
2 DIA station carried in E-5
3 North Suburban station carried in NS-1
4 South Suburban station carried in NS-2
5 DUS carried in NS-1
6 Golden station not included - is part of AGS Study
7 74th ave station carried on E-5

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W4		Segment E4		Segment NS-1		Segment NS-2	
	ICS: Denver Metro Capital Cost Estimate		From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to DUS		DUS to DIA		E470/I-76 to DUS		DUS to C470/US-85	
	Scenario A1 - US 6		Host Carrier	Greenfield		Greenfield		Greenfield/CML		CML/Brush Line/ Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
	Monday, June 24, 2013		Mileposts	0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		11.8 miles		13.3 miles		24.7 miles		24.2 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categotry	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.34	$ 237,734.96	0.87	$ 47,754.62	3.07	$ 168,179.32	11.97	$ 656,106.97
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.34	$ 24,995.45	0.19	$ 13,886.36	0.21	$ 15,275.00	1.04	$ 76,375.00
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.53	$ 44,452.12	-	$ -	-	$ -	1.12	$ 93,666.97
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	1.00	$ 2,808.00	-	$ -	12.00	$ 33,696.00	4.00	$ 11,232.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	0.06	$ 8,365.11	0.27	$ 39,037.20	0.30	$ 44,613.94	-	$ -
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	0.27	$ 10,341.44	-	$ -
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25	0.21	$ 19,857.29	-	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	0.49	$ 4,793.26	1.06	$ 10,323.94	3.22	$ 31,340.53	2.31	$ 22,491.44
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	0.27	$ 7,164.66	0.91	$ 24,564.55	2.25	$ 60,899.60	2.61	$ 70,623.07
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	-	$ -	0.30	$ 14,237.88	0.19	$ 8,898.67	0.27	$ 12,458.14
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	1.00	$ 3,235.21	2.48	$ 7,996.46	6.90	$ 22,242.97	5.11	$ 16,481.25
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	9.30	$ 35,159.73	12.50	$ 47,237.50	1.53	$ 5,797.33
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	5.47	$ 27,367.424	-	$ -	1.86	$ 9,280.303	3.20	$ 16,003.788
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.30	$ 20,040.15	1.52	$ 5,725.76	3.47	$ 13,097.67	14.31	$ 54,075.49
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	11.78	$ 2,606.39	13.30	$ 2,942.67	24.74	$ 5,474.22	15.09	$ 3,338.66
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 383,562.74**		**$ 222,801.85**		**$ 490,434.46**		**$ 1,038,650.11**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	-	$ -	-	$ -	1.00	$ 25,000.000	1.00	$ 25,000.000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ -		$ 50,000.00		$ 75,000.00		$ 25,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	14.00	$ 66,976.00	-	$ -	2.00	$ 9,568.00	5.00	$ 23,920.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	186,600.00	$ 2,052.60	3,792,150.00	$ 41,713.65	2,667,456.00	$ 29,342.02	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	3,545,400.00	$ 77,998.80	421,350.00	$ 9,269.70	2,667,456.00	$ 58,684.03	8,329,888.00	$ 183,257.54
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 147,027.40**		**$ 50,983.35**		**$ 97,594.05**		**$ 207,177.54**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	11.78	$ 25,327.65	13.30	$ 28,595.41	24.74	$ 53,195.80	15.09	$ 32,443.50
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 25,327.65**		**$ 28,595.41**		**$ 53,195.80**		**$ 32,443.50**
60 ELECTRIC TRACTION															
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	11.78	$ 32,984.85	13.30	$ 37,240.53	24.74	$ 69,278.26	15.09	$ 42,252.00

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A1 - US 6

Monday, June 24, 2013

	Segment N-2	Segment S-3	Segment W4	Segment E4	Segment NS-1	Segment NS-2
Segment No.	Segment N-2	Segment S-3	Segment W4	Segment E4	Segment NS-1	Segment NS-2
From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25	E-470 @ I-25N to Pueblo Station	I-70/C470 to DUS	DUS to DIA	E470/I-76 to DUS	DUS to C470/US-85
Host Carrier	Greenfield	Greenfield	Greenfield/CML	CML/Brush Line/ Greenfield	Greenfield/Brush Line/ CML	CML/Joint Line/ Greenfield
Mileposts	0.0 miles	0.0 miles	0.0 miles	0.0 miles	0.0 miles	0.0 miles
Track Miles	39.7 miles	94.9 miles	11.8 miles	13.3 miles	24.7 miles	24.2 miles
	220.0 miles	220.0 miles	220.0 miles	220.0 miles	220.0 miles	220.0 miles

FRA Standard Cost Categoty	Description	Unit	Final Costs (2013)	N-2 Quantity	N-2 Amount	S-3 Quantity	S-3 Amount	W4 Quantity	W4 Amount	E4 Quantity	E4 Amount	NS-1 Quantity	NS-1 Amount	NS-2 Quantity	NS-2 Amount
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	11.78	$ 28,272.73	13.30	$ 31,920.45	24.74	$ 59,381.36	15.09	$ 36,216.00
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 61,257.58**		**$ 69,160.98**		**$ 128,659.62**		**$ 78,468.00**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 617,175.37		$ 421,541.59		$ 844,883.94		$ 1,381,739.14
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 157,379.72**		**$ 107,493.11**		**$ 215,445.40**		**$ 352,343.48**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		10%		34%		100%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		90%		66%		0%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	11.19	$ 35,179.00	1.33	$ 2,529.25	8.42	$ 17,251.29	24.16	$ 82,904.35
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.59	$ 925.76	11.97	$ 11,381.62	16.32	$ 16,720.88	-	$ -
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 36,104.76**		**$ 13,910.87**		**$ 33,972.16**		**$ 82,904.35**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 15,429.38**		**$ 10,538.54**		**$ 21,122.10**		**$ 34,543.48**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 247,826.770		$ 166,045.232		$ 334,627.079		$ 555,459.135
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**		**$ 1,073,916.01**		**$ 719,529.34**		**$ 1,450,050.68**		**$ 2,406,989.59**
	cost/mile (2013)			$	42,184.52	$	72,475.15	$	91,162.00	$	54,099.18	$	58,606.29	$	99,627.05

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470/Brush Line to the north suburban station was ADDED to NS-1
2 DUS to 6th ave/CML was carried on NS-2 and removed from W-4
3 DUS to 96th ave/brush line was carried on NS-1 and removed from E-4
4 DIA station carried in E-4
5 North Suburban station carried in NS-1
6 South Suburban station carried in NS-2
7 DUS carried in NS-1
8 Golden station not included - is part of AGS Study
9 land acquisition modifications made for new corridor urban/rural percentages to E4
10 land acquisition modifications made for new corridor length to W-4 and E-4
11 utility modifications made for new urban/rural percentages to E-4 and NS-1

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A1 - US 6

Monday, June 24, 2013

Segment No.	Scenerio A1-B Total
From - To	
Host Carrier	
Mileposts	
Track Miles	208.6 miles

FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	Quantity	Amount
10 TRACK STRUCTURES & TRACK					
10.01	**Track structure: Viaduct**				
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	**43.80**	$ 2,400,646
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	**4.61**	$ 338,027
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	**2.60**	$ 217,752
10.03	**Track structure: Undergrade Bridges**				
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	**117.00**	$ 328,536
10.07	**Track structure: Tunnel**				
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	**0.63**	$ 92,016
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	**-**	$ -
10.08	**Track structure: Retaining walls and systems**				
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	**1.04**	$ 40,574
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	**0.32**	$ 30,689
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	**12.46**	$ 121,318
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	**29.25**	$ 790,409
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	**0.76**	$ 35,595
10.09	**Track new construction: Conventional ballasted**				
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	**44.60**	$ 143,745
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	**58.49**	$ 221,026
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	**49.82**	$ 249,102
10.10	**Track new construction: Non-ballasted**				
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	**55.69**	$ 210,466
10.18	**Other linear structures including fencing, sound walls**				
10.18.01	Highway Barrier Type 6	LF	$ 1.43	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	**102.56**	$ 22,692
	Sub-total Track Structures & Track (A)				**$ 5,326,576**
20 STATIONS, TERMINALS, INTERMODAL					
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	**5.00**	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	**6.00**	$ 150,000
	Sub-total Stations, Terminals, Intermodal (B)				**$ 400,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS					
30.02	**Light maintenance facility**				
30.02.01	Layover Facility	EA	$ 10,504	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**				
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	**1.00**	$ 201,032
30.05	**Yard and yard track**				
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS					
40.05	**Site structures including retaining walls, sound walls**				
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	**42.00**	$ 200,928
40.07	**Purchase or lease of real estate**				
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	**24,577,086.00**	$ 270,348
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	**24,866,206.00**	$ 547,057
40.07.03	Relocation - Commercial	EA		**-**	$ -
40.07.04	Relocation - Residential	EA		**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 1,018,332**
50 COMMUNICATIONS & SIGNALING					
50.01	**Wayside signaling equipment**				
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	**199.55**	$ 429,038
	Sub-total Communications & Signaling (E)				**$ 429,038**
60 ELECTRIC TRACTION					
60.02	**Traction power supply: Substations**				
60.02.01	Traction Power Supply	Route Mile	$ 2,800	**199.55**	$ 558,748

See notes at bottom of page

	ICS: Denver Metro Capital Cost Estimate			Segment No.	Scenerio A1-B Total	
	Scenario A1 - US 6			From - To		
	Monday, June 24, 2013			Host Carrier		
				Mileposts		
				Track Miles	208.6 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**		**Quantity**	**Amount**
60.03	**Traction power distribution: Catenary and third rail**					
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400		**199.55**	$ 478,927
	Sub-total Electric Traction (F)					**$ 1,037,674**
	Sub-total Construction Elements (A+B+C+D+E+F)					$ 8,454,669
PROFESSIONAL SERVICES						
	Design Engineering	10%				
	Insurance and Bonding	2%				
	Program Management	4%				
	Construction Management & Inspection	6%				
	Engineering Services During Construction	2%				
	Integrated Testing and Commissioning	2%				
	Sub-total Professional Services (G)		26%			**$ 2,155,941**
UTILITY RELOCATION						
	Percentage of Route that is in Urban Areas				**57%**	
	Percentage of Route that is Outside of Urban Areas				**43%**	
	Through Urban Areas	6%	6%		**118.91**	$ 289,131
	Outside of Urban Areas	3%	3%		**89.69**	$ 109,038
	Sub-total Utility Relocation (H)					**$ 398,169**
ENVIRONMENTAL MITIGATION						
	Noise Mitigation	1%				
	Hazardous Waste	1%				
	Erosion Control	0.5%				
	Sub-total Environmental Mitigation (I)		2.5%			**$ 211,367**
CONTINGENCY						
	Design and Construction Contingency		30%			**$ 3,366,044**
2013 TOTAL SEGMENT COST (Sum A to J)						**$ 14,586,190**
	cost/mile (2013)				$ 69,913.24	

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470/Brush Line to the north suburban station was ADDED to NS-1
2 DUS to 6th ave/CML was carried on NS-2 and removed from W-4
3 DUS to 96th ave/brush line was carried on NS-1 and removed from E-4
4 DIA station carried in E-4
5 North Suburban station carried in NS-1
6 South Suburban station carried in NS-2
7 DUS carried in NS-1
8 Golden station not included - is part of AGS Study
9 land acquisition modifications made for new corridor urban/rural percentages to E4
10 land acquisition modifications made for new corridor length to W-4 and E-4
11 utility modifications made for new urban/rural percentages to E-4 and NS-1

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment B3		Segment B4	
ICS: Denver Metro Capital Cost Estimate			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		I-25/C470 to DIA		DIA to I-25/US-85/E470	
Scenario A5 - I-76			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield		Greenfield	
Monday, June 24, 2013			Mileposts	0.0 miles		0.0 miles		N/A		N/A		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		26.9 miles		17.3 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.83	$ 264,726.70	1.52	$ 83,051.52	6.63	$ 363,350.38	1.42	$ 77,860.80
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.11	$ 8,331.82	0.19	$ 13,886.36	0.08	$ 5,865.60	-	$ -
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.49	$ 41,276.97	-	$ -	-	$ -	-	$ -
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	14.00	$ 39,312.00	1.00	$ 2,808.00	4.00	$ 11,232.00	5.00	$ 14,040.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	-	$ -	0.27	$ 39,037.20	0.21	$ 30,672.08	0.42	$ 61,344.17
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	0.76	$ 29,641.52	0.83	$ 32,371.66
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25		$ -	0.21	$ 20,016.15
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	2.03	$ 19,726.10	1.50	$ 14,564.13	4.00	$ 38,899.13	2.63	$ 25,625.49
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	1.36	$ 36,846.82	1.31	$ 35,311.53	4.17	$ 112,587.50	1.61	$ 43,499.72
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.27	$ 12,458.14	0.30	$ 14,237.88	-	$ -	-	$ -
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	3.71	$ 11,964.17	3.49	$ 11,237.77	9.19	$ 29,605.21	5.76	$ 18,556.67
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	9.41	$ 35,544.79	4.55	$ 17,177.27	7.54	$ 28,485.64
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	8.45	$ 42,234.848	2.61	$ 13,068.182	6.29	$ 31,450.000	2.44	$ 12,200.000
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.92	$ 22,363.38	2.22	$ 8,373.92	6.86	$ 25,909.05	1.59	$ 6,012.05
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	18.08	$ 4,000.20	17.72	$ 3,920.55	26.89	$ 5,949.41	17.33	$ 3,834.26
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 503,241.15**		**$ 296,214.52**		**$ 702,339.16**		**$ 343,846.60**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	-	$ -	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	1.00	$ 25,000.000	-	$ -	1.00	$ 25,000.000	1.00	$ 25,000.000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 25,000.00		$ 50,000.00		$ 25,000.00		$ 25,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	9.00	$ 43,056.00	6.00	$ 28,704.00	-	$ -	1.00	$ 4,784.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	375,587.20	$ 4,131.46	3,391,132.80	$ 37,302.46	5,558,784.00	$ 61,146.62	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	7,136,156.80	$ 156,995.45	2,774,563.20	$ 61,040.39	2,382,336.00	$ 52,411.39	-	$ -
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 204,182.91**		**$ 127,046.85**		**$ 113,558.02**		**$ 4,784.00**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	18.08	$ 38,872.00	17.72	$ 38,098.00	26.89	$ 57,813.50	17.33	$ 37,259.50
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 38,872.00**		**$ 38,098.00**		**$ 57,813.50**		**$ 37,259.50**
60 ELECTRIC TRACTION															

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment B3		Segment B4	
ICS: Denver Metro Capital Cost Estimate			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		I-25/C470 to DIA		DIA to I-25/US-85/E470	
Scenario A5 - I-76			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield		Greenfield	
Monday, June 24, 2013			Mileposts	0.0 miles		0.0 miles		N/A		N/A		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		26.9 miles		17.3 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	18.08	$ 50,624.00	17.72	$ 49,616.00	26.89	$ 75,292.00	17.33	$ 48,524.00
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	18.08	$ 43,392.00	17.72	$ 42,528.00	26.89	$ 64,536.00	17.33	$ 41,592.00
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 94,016.00**		**$ 92,144.00**		**$ 139,828.00**		**$ 90,116.00**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 865,312.05		$ 603,503.37		$ 1,038,538.67		$ 501,006.10
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 220,654.57**		**$ 153,893.36**		**$ 264,827.36**		**$ 127,756.56**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		45%		34%		18%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		55%		66%		82%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	17.18	$ 49,322.79	7.97	$ 16,294.59	9.02	$ 20,911.36	3.09	$ 5,352.06
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.90	$ 1,297.97	9.75	$ 9,957.81	17.87	$ 20,705.12	14.21	$ 12,324.23
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 50,620.76**		**$ 26,252.40**		**$ 41,616.47**		**$ 17,676.29**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 21,632.80**		**$ 15,087.58**		**$ 25,963.47**		**$ 12,525.15**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 347,466.056		$ 239,621.012		$ 411,283.793		$ 197,689.230
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**	**$ -**	**$ 1,505,686.24**	**$ -**	**$ 1,038,357.72**		**$ 1,782,229.77**		**$ 856,653.33**
	cost/mile (2013)			$ 42,184.52		$ 72,475.15		$ 83,279.11		$ 58,598.07		$ 66,278.53		$ 49,431.81	

Scenerio A5 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the E-5 segment and was removed from B-3 and B-4
2 DIA station carried in E-5
3 North Suburban station carried in B4
4 South Suburban station carried in B-3
5 74th was carried on W-5
6 Golden station not included - is part of AGS Study

See notes at bottom of page

			Segment No.	Scenerio A5-A Total
ICS: Denver Metro Capital Cost Estimate			From - To	
Scenario A5 - I-76			Host Carrier	
Monday, June 24, 2013			Mileposts	
			Track Miles	214.7 miles

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount
10 TRACK STRUCTURES & TRACK					
10.01	**Track structure: Viaduct**				
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	**37.94**	$ 2,079,859
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	**3.21**	$ 235,579
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	**1.44**	$ 120,910
10.03	**Track structure: Undergrade Bridges**				
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	**124.00**	$ 348,192
10.07	**Track structure: Tunnel**				
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	**0.89**	$ 131,053
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	**-**	$ -
10.08	**Track structure: Retaining walls and systems**				
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	**2.37**	$ 92,246
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	**0.32**	$ 30,847
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	**15.53**	$ 151,184
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	**31.66**	$ 855,403
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	**0.57**	$ 26,696
10.09	**Track new construction: Conventional ballasted**				
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	**51.24**	$ 165,153
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	**56.64**	$ 214,040
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	**59.08**	$ 295,403
10.10	**Track new construction: Non-ballasted**				
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	**47.68**	$ 180,185
10.18	**Other linear structures including fencing, sound walls**				
10.18.01	Highway Barrier Type 6	LF	$ 1.43	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	**117.67**	$ 26,034
	Sub-total Track Structures & Track (A)				**$ 5,036,769**
20 STATIONS, TERMINALS, INTERMODAL					
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	**4.00**	$ 200,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	**7.00**	$ 175,000
	Sub-total Stations, Terminals, Intermodal (B)				**$ 375,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS					
30.02	**Light maintenance facility**				
30.02.01	Layover Facility	EA	$ 10,504	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**				
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	**1.00**	$ 201,032
30.05	**Yard and yard track**				
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS					
40.05	**Site structures including retaining walls, sound walls**				
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	**37.00**	$ 177,008
40.07	**Purchase or lease of real estate**				
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	**27,256,384.00**	$ 299,820
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	**22,195,168.00**	$ 488,294
40.07.03	Relocation - Commercial	EA		**-**	$ -
40.07.04	Relocation - Residential	EA		**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 965,122**
50 COMMUNICATIONS & SIGNALING					
50.01	**Wayside signaling equipment**				
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	**214.66**	$ 461,519
	Sub-total Communications & Signaling (E)				**$ 461,519**
60 ELECTRIC TRACTION					

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A5 - I-76

Monday, June 24, 2013

Segment No.	Scenerio A5-A Total
From - To	
Host Carrier	
Mileposts	
Track Miles	214.7 miles

FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	Quantity	Amount
60.02	**Traction power supply: Substations**				
60.02.01	Traction Power Supply	Route Mile	$ 2,800	**214.66**	$ 601,048
60.03	**Traction power distribution: Catenary and third rail**				
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	**214.66**	$ 515,184
	Sub-total Electric Traction (F)				**$ 1,116,232**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 8,197,690**
PROFESSIONAL SERVICES					
	Design Engineering	10%			
	Insurance and Bonding	2%			
	Program Management	4%			
	Construction Management & Inspection	6%			
	Engineering Services During Construction	2%			
	Integrated Testing and Commissioning	2%			
	Sub-total Professional Services (G)		26%		**$ 2,090,411**
UTILITY RELOCATION					
	Percentage of Route that is in Urban Areas			**52%**	
	Percentage of Route that is Outside of Urban Areas			**48%**	
	Through Urban Areas	6%	6%	**111.07**	$ 254,491
	Outside of Urban Areas	3%	3%	**103.54**	$ 118,616
	Sub-total Utility Relocation (H)				**$ 373,107**
ENVIRONMENTAL MITIGATION					
	Noise Mitigation	1%			
	Hazardous Waste	1%			
	Erosion Control	0.5%			
	Sub-total Environmental Mitigation (I)		2.5%		**$ 204,942**
CONTINGENCY					
	Design and Construction Contingency		30%		**$ 3,259,845**
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 14,125,994**
	cost/mile (2013)			$ 65,803.30	

Scenerio A5 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-5 segment and was removed from B-3 and B-4
2. DIA station carried in E-5
3. North Suburban station carried in B4
4. South Suburban station carried in B-3
5. 74th was carried on W-5
6. Golden station not included - is part of AGS Study

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A5 - US 6

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W4		Segment E4		Segment B3		Segment B4	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to DUS		DUS to DIA		I-25/C470 to DIA		DIA to I-25/US-85/E470	
			Host Carrier	Greenfield		Greenfield		Greenfield/CML		CML/Brush Line/ Greenfield		Greenfield		Greenfield	
			Mileposts	0.0 miles		0.0 miles		0.0 miles		0.0 miles		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		13.4 miles		23.2 miles		26.9 miles		17.3 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.34	$ 237,734.96	2.31	$ 126,653.56	6.63	$ 363,350.38	1.42	$ 77,860.80
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.81	$ 59,711.36	0.40	$ 29,161.36	0.08	$ 5,865.60	-	$ -
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.93	$ 77,791.21	-	$ -	-	$ -	-	$ -
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	3.00	$ 8,424.00	9.00	$ 25,272.00	4.00	$ 11,232.00	5.00	$ 14,040.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	0.06	$ 8,365.11	0.27	$ 39,037.20	0.21	$ 30,672.08	0.42	$ 61,344.17
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	0.76	$ 29,641.52	0.83	$ 32,371.66
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25		$ -	0.21	$ 20,016.15
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	0.64	$ 6,268.11	2.54	$ 24,703.71	4.00	$ 38,899.13	2.63	$ 25,625.49
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	0.40	$ 10,746.99	2.10	$ 56,805.51	4.17	$ 112,587.50	1.61	$ 43,499.72
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	-	$ -	0.49	$ 23,136.55	-	$ -	-	$ -
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	1.27	$ 4,089.79	5.40	$ 17,396.88	9.19	$ 29,605.21	5.76	$ 18,556.67
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	0.46	$ 1,755.66	14.59	$ 55,128.31	4.55	$ 17,177.27	7.54	$ 28,485.64
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	5.47	$ 27,367.424	-	$ -	6.29	$ 31,450.000	2.44	$ 12,200.000
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	6.19	$ 23,404.03	3.14	$ 11,880.95	6.86	$ 25,909.05	1.59	$ 6,012.05
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	13.40	$ 2,964.75	23.15	$ 5,121.94	26.89	$ 5,949.41	17.33	$ 3,834.26
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 468,623.41**		**$ 435,470.66**		**$ 702,339.16**		**$ 343,846.60**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	-	$ -	-	$ -	1.00	$ 25,000.000	1.00	$ 25,000.000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 50,000.00		$ 50,000.00		$ 25,000.00		$ 25,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	15.00	$ 71,760.00	1.00	$ 4,784.00	-	$ -	1.00	$ 4,784.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	270,056.00	$ 2,970.62	4,400,352.00	$ 48,403.87	5,558,784.00	$ 61,146.62	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	5,131,064.00	$ 112,883.41	2,933,568.00	$ 64,538.50	2,382,336.00	$ 52,411.39	-	$ -
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 187,614.02**		**$ 117,726.37**		**$ 113,558.02**		**$ 4,784.00**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	13.40	$ 28,810.00	23.15	$ 49,772.50	26.89	$ 57,813.50	17.33	$ 37,259.50
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 28,810.00**		**$ 49,772.50**		**$ 57,813.50**		**$ 37,259.50**
60 ELECTRIC TRACTION															

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W4		Segment E4		Segment B3		Segment B4	
ICS: Denver Metro Capital Cost Estimate **Scenario A5 - US 6** Monday, June 24, 2013			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to DUS		DUS to DIA		I-25/C470 to DIA		DIA to I-25/US-85/E470	
			Host Carrier	Greenfield		Greenfield		Greenfield/CML		CML/Brush Line/ Greenfield		Greenfield		Greenfield	
			Mileposts	0.0 miles		0.0 miles		0.0 miles		0.0 miles		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		13.4 miles		23.2 miles		26.9 miles		17.3 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	13.40	$ 37,520.00	23.15	$ 64,820.00	26.89	$ 75,292.00	17.33	$ 48,524.00
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	13.40	$ 32,160.00	23.15	$ 55,560.00	26.89	$ 64,536.00	17.33	$ 41,592.00
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 69,680.00**		**$ 120,380.00**		**$ 139,828.00**		**$ 90,116.00**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 804,727.43		$ 773,349.52		$ 1,038,538.67		$ 501,006.10
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 205,205.49**		**$ 197,204.13**		**$ 264,827.36**		**$ 127,756.56**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		40%		34%		18%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		60%		66%		82%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	12.73	$ 45,869.46	9.26	$ 18,560.39	9.02	$ 20,911.36	3.09	$ 5,352.06
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.67	$ 1,207.09	13.89	$ 13,920.29	17.87	$ 20,705.12	14.21	$ 12,324.23
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 47,076.55**		**$ 32,480.68**		**$ 41,616.47**		**$ 17,676.29**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 20,118.19**		**$ 19,333.74**		**$ 25,963.47**		**$ 12,525.15**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 323,138.300		$ 306,710.421		$ 411,283.793		$ 197,689.230
2013 TOTAL SEGMENT COST (Sum A to J)					$ 1,675,991.16		$ 6,879,341.36	$ -	$ 1,400,265.97	$ -	$ 1,329,078.49		$ 1,782,229.77		$ 856,653.33
	cost/mile (2013)			$	42,184.52	$	72,475.15	$	104,497.46	$	57,411.60	$	66,278.53	$	49,431.81

Scenerio A5 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-4 segment and was removed from B-3 and B-4
2. DIA station carried in E-4
3. North Suburban station carried in B4
4. South Suburban station carried in B-3
5. DUS carried in W-4
6. Golden station not included - is part of AGS Study

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A5 - US 6

Monday, June 24, 2013

Segment No.	Scenerio A5-B Total
From - To	
Host Carrier	
Mileposts	
Track Miles	215.4 miles

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount
10 TRACK STRUCTURES & TRACK					
10.01	**Track structure: Viaduct**				
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	**38.25**	$ 2,096,469
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	**4.12**	$ 302,234
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	**1.88**	$ 157,424
10.03	**Track structure: Undergrade Bridges**				
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	**121.00**	$ 339,768
10.07	**Track structure: Tunnel**				
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	**0.95**	$ 139,419
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	**-**	$ -
10.08	**Track structure: Retaining walls and systems**				
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	**2.37**	$ 92,246
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	**0.32**	$ 30,847
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	**15.19**	$ 147,865
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	**31.49**	$ 850,797
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	**0.49**	$ 23,137
10.09	**Track new construction: Conventional ballasted**				
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	**50.71**	$ 163,438
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	**62.29**	$ 235,379
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	**53.49**	$ 267,467
10.10	**Track new construction: Non-ballasted**				
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	**48.88**	$ 184,733
10.18	**Other linear structures including fencing, sound walls**				
10.18.01	Highway Barrier Type 6	LF	$ 1.43	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	**118.42**	$ 26,200
	Sub-total Track Structures & Track (A)				**$ 5,141,407**
20 STATIONS, TERMINALS, INTERMODAL					
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	**5.00**	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	**6.00**	$ 150,000
	Sub-total Stations, Terminals, Intermodal (B)				**$ 400,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS					
30.02	**Light maintenance facility**				
30.02.01	Layover Facility	EA	$ 10,504	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**				
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	**1.00**	$ 201,032
30.05	**Yard and yard track**				
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS					
40.05	**Site structures including retaining walls, sound walls**				
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	**38.00**	$ 181,792
40.07	**Purchase or lease of real estate**				
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	**28,160,072.00**	$ 309,761
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	**20,349,080.00**	$ 447,680
40.07.03	Relocation - Commercial	EA		**-**	$ -
40.07.04	Relocation - Residential	EA		**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 939,233**
50 COMMUNICATIONS & SIGNALING					
50.01	**Wayside signaling equipment**				
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	**215.41**	$ 463,132
	Sub-total Communications & Signaling (E)				**$ 463,132**
60 ELECTRIC TRACTION					

See notes at bottom of page			Segment No.		Scenerio A5-B Total	
	ICS: Denver Metro Capital Cost Estimate		From - To			
	Scenario A5 - US 6		Host Carrier			
	Monday, June 24, 2013		Mileposts			
			Track Miles		215.4 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**		**Quantity**	**Amount**
60.02	**Traction power supply: Substations**					
60.02.01	Traction Power Supply	Route Mile	$ 2,800		**215.41**	$ 603,148
60.03	**Traction power distribution: Catenary and third rail**					
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400		**215.41**	$ 516,984
	Sub-total Electric Traction (F)					$ 1,120,132
	Sub-total Construction Elements (A+B+C+D+E+F)					$ 8,306,951
PROFESSIONAL SERVICES						
	Design Engineering	10%				
	Insurance and Bonding	2%				
	Program Management	4%				
	Construction Management & Inspection	6%				
	Engineering Services During Construction	2%				
	Integrated Testing and Commissioning	2%				
	Sub-total Professional Services (G)		26%			$ 2,118,273
UTILITY RELOCATION						
	Percentage of Route that is in Urban Areas				50%	
	Percentage of Route that is Outside of Urban Areas				50%	
	Through Urban Areas	6%	6%		**107.91**	$ 249,674
	Outside of Urban Areas	3%	3%		**107.45**	$ 124,302
	Sub-total Utility Relocation (H)					$ 373,975
ENVIRONMENTAL MITIGATION						
	Noise Mitigation	1%				
	Hazardous Waste	1%				
	Erosion Control	0.5%				
	Sub-total Environmental Mitigation (I)		2.5%			$ 207,674
CONTINGENCY						
	Design and Construction Contingency		30%			$ 3,302,062
2013 TOTAL SEGMENT COST (Sum A to J)						$ 14,308,935
	cost/mile (2013)				$	66,423.43

Scenerio A5 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-4 segment and was removed from B-3 and B-4
2. DIA station carried in E-4
3. North Suburban station carried in B4
4. South Suburban station carried in B-3
5. DUS carried in W-4
6. Golden station not included - is part of AGS Study

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W4		Segment E4		Segment NS-1		Segment NS-2	
	ICS: Denver Metro Capital Cost Estimate		From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to DUS		DUS to DIA		E470/I-76 to DUS		DUS to C470/US-85	
	Scenario A6		Host Carrier	Greenfield		Greenfield		Greenfield/CML		CML/Brush Line/ Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
	Monday, June 24, 2013		Mileposts	0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		11.8 miles		13.3 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categoty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.34	$ 237,734.96	0.87	$ 47,754.62	2.31	$ 126,653.56	9.47	$ 519,071.97
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.34	$ 24,995.45	0.19	$ 13,886.36	0.21	$ 15,275.00	0.72	$ 52,768.18
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.53	$ 44,452.12	-	$ -	-	$ -	1.08	$ 90,491.82
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	1.00	$ 2,808.00	-	$ -	10.00	$ 28,080.00	2.00	$ 5,616.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	0.06	$ 8,365.11	0.27	$ 39,037.20	-	$ -	-	$ -
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	-	$ -	-	$ -
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25	-	$ -	-	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	0.49	$ 4,793.26	1.06	$ 10,323.94	2.23	$ 21,754.02	0.80	$ 7,742.95
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	0.27	$ 7,164.66	0.91	$ 24,564.55	1.91	$ 51,687.90	0.72	$ 19,446.93
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	-	$ -	0.30	$ 14,237.88	0.19	$ 8,898.67	0.19	$ 8,898.67
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	1.00	$ 3,235.21	2.48	$ 7,996.46	4.51	$ 14,527.92	1.61	$ 5,188.54
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	9.30	$ 35,159.73	9.15	$ 34,569.26	1.53	$ 5,797.33
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	5.47	$ 27,367.424	-	$ -	-	$ -	-	$ -
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.30	$ 20,040.15	1.52	$ 5,725.76	2.42	$ 9,161.21	11.36	$ 42,943.18
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	11.78	$ 2,606.39	13.30	$ 2,942.67	16.10	$ 3,561.79	14.51	$ 3,209.80
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 383,562.74**		**$ 222,801.85**		**$ 314,169.33**		**$ 761,175.38**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ -		$ 50,000.00		$ 50,000.00		$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	14.00	$ 66,976.00	-	$ -	2.00	$ 9,568.00	4.00	$ 19,136.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	186,600.00	$ 2,052.60	3,792,150.00	$ 41,713.65	2,550,000.00	$ 28,050.00	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	3,545,400.00	$ 77,998.80	421,350.00	$ 9,269.70	2,550,000.00	$ 56,100.00	4,596,000.00	$ 101,112.00
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 147,027.40**		**$ 50,983.35**		**$ 93,718.00**		**$ 120,248.00**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	11.78	$ 25,327.65	13.30	$ 28,595.41	16.10	$ 34,611.74	14.51	$ 31,191.29
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 25,327.65**		**$ 28,595.41**		**$ 34,611.74**		**$ 31,191.29**
60 ELECTRIC TRACTION															
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	11.78	$ 32,984.85	13.30	$ 37,240.53	16.10	$ 45,075.76	14.51	$ 40,621.21

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W4		Segment E4		Segment NS-1		Segment NS-2	
ICS: Denver Metro Capital Cost Estimate			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to DUS		DUS to DIA		E470/I-76 to DUS		DUS to C470/US-85	
Scenario A6			Host Carrier	Greenfield		Greenfield		Greenfield/CML		CML/Brush Line/ Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
Monday, June 24, 2013			Mileposts	0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		11.8 miles		13.3 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	11.78	$ 28,272.73	13.30	$ 31,920.45	16.10	$ 38,636.36	14.51	$ 34,818.18
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 61,257.58**		**$ 69,160.98**		**$ 83,712.12**		**$ 75,439.39**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 978,556.34**		**$ 3,978,229.04**		**$ 617,175.37**		**$ 421,541.59**		**$ 576,211.19**		**$ 988,054.07**
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 157,379.72**		**$ 107,493.11**		**$ 146,933.85**		**$ 251,953.79**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		10%		50%		100%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		90%		50%		0%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	11.19	$ 35,179.00	1.33	$ 2,529.25	8.05	$ 17,286.34	14.51	$ 59,283.24
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.59	$ 925.76	11.97	$ 11,381.62	8.05	$ 8,643.17	-	$ -
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 36,104.76**		**$ 13,910.87**		**$ 25,929.50**		**$ 59,283.24**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 15,429.38**		**$ 10,538.54**		**$ 14,405.28**		**$ 24,701.35**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 247,826.770		$ 166,045.232		$ 229,043.949		$ 397,197.735
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**		**$ 1,073,916.01**		**$ 719,529.34**		**$ 992,523.78**		**$ 1,721,190.18**
	cost/mile (2013)			$	42,184.52	$	72,475.15	$	91,162.00	$	54,099.18	$	61,653.24	$	118,640.79

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the E-4 segment and was removed from B-3 and B-4
2 E-470 to the north suburban station is carried on the B1 and removed from B4
3 Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4 DUS to 6th ave/CML was carried on NS-2 and removed from W-4
5 DUS to 96th ave/brush line was carried on NS-1 and removed from E-4
6 Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
7 DIA station carried in E-4
8 North Suburban station carried in B1
9 South Suburban station carried in B-2
10 DUS carried in NS-1
11 Golden station not included - is part of AGS Study
12 land acquisition modifications made for new corridor urban/rural percentages to E-4
13 land acquisition modifications made for new corridor length to W-4, E-4, NS-1 and NS-2
14 utility modifications made for new urban/rural percentages to E-4

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6

Monday, June 24, 2013

			Segment No.	Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6 Total	
			From - To	I-25/US-85/E470 to I-70/C470		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield			
			Mileposts	N/A		N/A		N/A		N/A			
			Track Miles	32.7 miles		26.3 miles		26.9 miles		16.7 miles		292.9 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK													
10.01	**Track structure: Viaduct**												
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	4.49	$ 246,114.86	5.42	$ 297,091.88	6.63	$ 363,350.38	1.42	$ 77,860.80	**58.50**	$ 3,206,503
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	0.23	$ 16,863.60	0.17	$ 12,464.40	0.08	$ 5,865.60	-	$ -	**4.77**	$ 349,614
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.11	$ 9,220.64	-	$ -	-	$ -	-	$ -	**2.67**	$ 223,797
10.03	**Track structure: Undergrade Bridges**												
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	1.00	$ 2,808.00	6.00	$ 16,848.00	4.00	$ 11,232.00	4.00	$ 11,232.00	**128.00**	$ 359,424
10.07	**Track structure: Tunnel**												
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	0.08	$ 11,778.08	0.04	$ 5,889.04	0.21	$ 30,672.08	0.42	$ 61,344.17	**1.07**	$ 157,086
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.08	**Track structure: Retaining walls and systems**												
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.38	$ 14,820.76	-	$ -	0.76	$ 29,641.52	0.83	$ 32,371.66	**2.75**	$ 107,066
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -		$ -	0.21	$ 20,016.15	**0.32**	$ 30,847
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.06	$ 49,223.07	4.36	$ 42,440.24	4.00	$ 38,899.13	2.59	$ 25,256.78	**25.97**	$ 252,802
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	8.39	$ 226,706.19	4.64	$ 125,377.44	4.17	$ 112,587.50	1.61	$ 43,499.72	**45.82**	$ 1,238,192
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	0.38	$ 17,854.30	0.19	$ 8,927.15	-	$ -	-	$ -	**1.25**	$ 58,817
10.09	**Track new construction: Conventional ballasted**												
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	15.09	$ 48,650.21	9.32	$ 30,038.36	9.19	$ 29,605.21	5.70	$ 18,373.54	**78.00**	$ 251,405
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	8.28	$ 31,276.95	2.85	$ 10,770.15	4.55	$ 17,177.27	7.20	$ 27,197.35	**78.00**	$ 294,780
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	4.62	$ 23,106.061	8.41	$ 42,050.000	6.29	$ 31,450.000	2.20	$ 10,984.848	**66.28**	$ 331,408
10.10	**Track new construction: Non-ballasted**												
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	4.05	$ 15,304.95	5.72	$ 21,615.88	6.86	$ 25,909.05	1.59	$ 6,012.05	**69.92**	$ 264,239
10.18	**Other linear structures including fencing, sound walls**												
10.18.01	Highway Barrier Type 6	LF	$ 1.43	-	$ -	-	$ -	-	$ -	-	$ -	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	-	$ -	-	$ -	-	$ -	-	$ -	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	32.73	$ 7,241.51	26.25	$ 5,808.49	26.89	$ 5,949.41	16.67	$ 3,688.24	**195.88**	$ 43,338
	Sub-total Track Structures & Track (A)				**$ 720,969.18**		**$ 619,321.03**		**$ 702,339.16**		**$ 337,837.29**		**$ 7,253,303**
20 STATIONS, TERMINALS, INTERMODAL													
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	-	$ -	-	$ -	-	$ -	-	$ -	**5.00**	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	1.00	$ 25,000.000	-	$ -	-	$ -	**6.00**	$ 150,000
	Sub-total Stations, Terminals, Intermodal (B)				$ 25,000.00		$ 25,000.00		$ -		$ -		**$ 400,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS													
30.02	**Light maintenance facility**												
30.02.01	Layover Facility	EA	$ 10,504	-	$ -	-	$ -	-	$ -	-	$ -	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**												
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	**1.00**	$ 201,032
30.05	**Yard and yard track**												
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ -**		**$ -**		**$ -**		**$ -**		**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS													
40.05	**Site structures including retaining walls, sound walls**												
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	-	$ -	-	$ -	-	$ -	1.00	$ 4,784.00	**42.00**	$ 200,928
40.07	**Purchase or lease of real estate**												
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	13,226,400.00	$ 145,490.40	4,164,336.00	$ 45,807.70	5,558,784.00	$ 61,146.62	-	$ -	**47,409,150.00**	$ 521,501
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	4,408,800.00	$ 96,993.60	2,776,224.00	$ 61,076.93	2,382,336.00	$ 52,411.39	-	$ -	**30,582,222.00**	$ 672,809
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 242,484.00**		**$ 106,884.62**		**$ 113,558.02**		**$ 4,784.00**		**$ 1,395,238**
50 COMMUNICATIONS & SIGNALING													
50.01	**Wayside signaling equipment**												
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	32.73	$ 70,369.50	26.29	$ 56,523.50	26.89	$ 57,813.50	16.67	$ 35,840.50	**292.91**	$ 629,749
	Sub-total Communications & Signaling (E)				**$ 70,369.50**		**$ 56,523.50**		**$ 57,813.50**		**$ 35,840.50**	**-**	**$ 629,749**
60 ELECTRIC TRACTION													
60.02	**Traction power supply: Substations**												
60.02.01	Traction Power Supply	Route Mile	$ 2,800	32.73	$ 91,644.00	26.29	$ 73,612.00	26.89	$ 75,292.00	16.67	$ 46,676.00	**292.91**	$ 820,138

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6

Monday, June 24, 2013

				Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6 Total	
			Segment No.	Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6 Total	
			From - To	I-25/US-85/E470 to I-70/C470		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield			
			Mileposts	N/A		N/A		N/A		N/A			
			Track Miles	32.7 miles		26.3 miles		26.9 miles		16.7 miles		292.9 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.03	**Traction power distribution: Catenary and third rail**												
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	32.73	$ 78,552.00	26.29	$ 63,096.00	26.89	$ 64,536.00	16.67	$ 40,008.00	**292.91**	$ 702,976
	Sub-total Electric Traction (F)				**$ 170,196.00**		**$ 136,708.00**		**$ 139,828.00**		**$ 86,684.00**		**$ 1,523,114**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 1,229,018.68		$ 944,437.15		$ 1,013,538.67		$ 465,145.79		$ 11,444,452
PROFESSIONAL SERVICES													
	Design Engineering	10%											
	Insurance and Bonding	2%											
	Program Management	4%											
	Construction Management & Inspection	6%											
	Engineering Services During Construction	2%											
	Integrated Testing and Commissioning	2%											
	Sub-total Professional Services (G)		26%		**$ 313,399.76**		**$ 240,831.47**		**$ 258,452.36**		**$ 118,612.18**		**$ 2,918,335**
UTILITY RELOCATION													
	Percentage of Route that is in Urban Areas			26%		40%		34%		19%		**48%**	
	Percentage of Route that is Outside of Urban Areas			74%		60%		66%		81%		**52%**	
	Through Urban Areas	6%	6%	8.35	$ 18,812.66	10.52	$ 22,666.49	9.02	$ 20,407.97	3.09	$ 5,165.71	**139.87**	$ 327,878
	Outside of Urban Areas	3%	3%	24.35	$ 27,430.44	15.77	$ 16,999.87	17.87	$ 20,206.70	13.58	$ 11,371.52	**153.00**	$ 179,329
	Sub-total Utility Relocation (H)				**$ 46,243.10**		**$ 39,666.36**		**$ 40,614.67**		**$ 16,537.23**		**$ 507,207**
ENVIRONMENTAL MITIGATION													
	Noise Mitigation	1%											
	Hazardous Waste	1%											
	Erosion Control	0.5%											
	Sub-total Environmental Mitigation (I)		2.5%		**$ 30,725.47**		**$ 23,610.93**		**$ 25,338.47**		**$ 11,628.64**		**$ 286,111**
CONTINGENCY													
	Design and Construction Contingency		30%		$ 485,816.102		$ 374,563.774		$ 401,383.251		$ 183,577.152		$ 4,546,832
2013 TOTAL SEGMENT COST (Sum A to J)					$ 2,105,203.11		$ 1,623,109.69		$ 1,739,327.42		$ 795,500.99		$ 19,702,937
	cost/mile (2013)			$ 64,320.29		$ 61,738.67		$ 64,683.06		$ 47,720.52		$ 67,264.68	

Scenerio A6 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the E-4 segment and was removed from B-3 and B-4
2 E-470 to the north suburban station is carried on the B1 and removed from B4
3 Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4 DUS to 6th ave/CML was carried on NS-2 and removed from W-4
5 DUS to 96th ave/brush line was carried on NS-1 and removed from E-4
6 Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
7 DIA station carried in E-4
8 North Suburban station carried in B1
9 South Suburban station carried in B-2
10 DUS carried in NS-1
11 Golden station not included - is part of AGS Study
12 land acquisition modifications made for new corridor urban/rural percentages to E-4
13 land acquisition modifications made for new corridor length to W-4, E-4, NS-1 and NS-2
14 utility modifications made for new urban/rural percentages to E-4

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D1

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W3		Segment E3		Segment NS-1		Segment NS-2	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to N. Metro Stockyard Station		N. Metro Stockyard Station to DIA		E470/I-76 to DUS		DUS to C470/US-85	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		16.0 miles		20.0 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categotry	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.51	$ 247,078.26	5.64	$ 309,366.89	2.31	$ 126,653.56	9.47	$ 519,071.97
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.15	$ 11,109.09	0.55	$ 40,270.45	0.21	$ 15,275.00	0.72	$ 52,768.18
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.49	$ 41,276.97	-	$ -	-	$ -	1.08	$ 90,491.82
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	9.00	$ 25,272.00	4.00	$ 11,232.00	10.00	$ 28,080.00	2.00	$ 5,616.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	-	$ -	0.23	$ 33,460.45	-	$ -	-	$ -
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	1.23	$ 11,983.14	2.16	$ 21,016.59	2.23	$ 21,754.02	0.80	$ 7,742.95
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	0.61	$ 16,376.36	1.82	$ 49,129.09	1.91	$ 51,687.90	0.72	$ 19,446.93
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.19	$ 8,898.67	0.19	$ 8,898.67	0.19	$ 8,898.67	0.19	$ 8,898.67
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	2.08	$ 6,714.58	3.88	$ 12,513.54	4.51	$ 14,527.92	1.61	$ 5,188.54
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	6.04	$ 22,831.46	9.15	$ 34,569.26	1.53	$ 5,797.33
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	8.58	$ 42,897.727	3.24	$ 16,193.182	-	$ -	-	$ -
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.34	$ 20,184.01	6.84	$ 25,837.48	2.42	$ 9,161.21	11.36	$ 42,943.18
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	16.00	$ 3,540.00	20.00	$ 4,425.00	16.10	$ 3,561.79	14.51	$ 3,209.80
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 435,330.82**		**$ 555,174.82**		**$ 314,169.33**		**$ 761,175.38**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	1.00	$ 25,000.000	-	$ -	-	$ -	-	$ -
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 25,000.00		$ 50,000.00		$ 50,000.00		$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	9.00	$ 43,056.00	7.00	$ 33,488.00	2.00	$ 9,568.00	4.00	$ 19,136.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	344,040.00	$ 3,784.44	2,106,000.00	$ 23,166.00	2,550,000.00	$ 28,050.00	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	6,536,760.00	$ 143,808.72	4,914,000.00	$ 108,108.00	2,550,000.00	$ 56,100.00	4,596,000.00	$ 101,112.00
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 190,649.16**		**$ 164,762.00**		**$ 93,718.00**		**$ 120,248.00**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	16.00	$ 34,400.00	20.00	$ 43,000.00	16.10	$ 34,611.74	14.51	$ 31,191.29
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 34,400.00**		**$ 43,000.00**		**$ 34,611.74**		**$ 31,191.29**
60 ELECTRIC TRACTION															
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	16.00	$ 44,800.00	20.00	$ 56,000.00	16.10	$ 45,075.76	14.51	$ 40,621.21

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D1

Monday, June 24, 2013

FRA Standard Cost Catetgory	Description	Unit	Final Costs (2013)	Segment N-2		Segment S-3		Segment W3		Segment E3		Segment NS-1		Segment NS-2	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to N. Metro Stockyard Station		N. Metro Stockyard Station to DIA		E470/I-76 to DUS		DUS to C470/US-85	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		16.0 miles		20.0 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
				Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	16.00	$ 38,400.00	20.00	$ 48,000.00	16.10	$ 38,636.36	14.51	$ 34,818.18
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 83,200.00**		**$ 104,000.00**		**$ 83,712.12**		**$ 75,439.39**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 768,579.98		$ 916,936.82		$ 576,211.19		$ 988,054.07
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 195,987.90**		**$ 233,818.89**		**$ 146,933.85**		**$ 251,953.79**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		70%		50%		100%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		30%		50%		0%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	15.20	$ 43,809.06	14.00	$ 38,511.35	8.05	$ 17,286.34	14.51	$ 59,283.24
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.80	$ 1,152.87	6.00	$ 8,252.43	8.05	$ 8,643.17	-	$ -
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 44,961.93**		**$ 46,763.78**		**$ 25,929.50**		**$ 59,283.24**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 19,214.50**		**$ 22,923.42**		**$ 14,405.28**		**$ 24,701.35**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 308,623.292		$ 366,132.873		$ 229,043.949		$ 397,197.735
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**	$ -	**$ 1,337,367.60**	$ -	**$ 1,586,575.78**		**$ 992,523.78**		**$ 1,721,190.18**
	cost/mile (2013)			$ 42,184.52		$ 72,475.15		$ 83,585.47		$ 79,328.79		$ 61,653.24		$ 118,640.79	

Scenerio A6-D1 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-3 segment and was removed from B-3 and B-4
2. E-470 to the north suburban station is carried on the B1 and removed from B4
3. Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4. Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
5. DIA station carried in E-3
6. North Suburban station carried in B1
7. South Suburban station carried in B-2
8. DUS carried in NS-1
9. 1-70/stockshow station carried on W-3
10. Golden station not included - is part of AGS Study
11. land acquisition modifications made for new corridor length to NS-1 and NS-2

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D1

Monday, June 24, 2013

			Segment No.	Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6 -D1 Total	
			From - To	I-25/US-85/E470 to I-70/C470		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield			
			Mileposts	N/A		N/A		N/A		N/A			
			Track Miles	32.7 miles		26.3 miles		26.9 miles		16.7 miles		303.8 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
10 TRACK STRUCTURES & TRACK													
10.01	Track structure: Viaduct												
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	4.49	$ 246,114.86	5.42	$ 297,091.88	6.63	$ 363,350.38	1.42	$ 77,860.80	63.44	$ 3,477,458
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	0.23	$ 16,863.60	0.17	$ 12,464.40	0.08	$ 5,865.60	-	$ -	4.94	$ 362,112
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.11	$ 9,220.64	-	$ -	-	$ -	-	$ -	2.63	$ 220,622
10.03	Track structure: Undergrade Bridges												
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	1.00	$ 2,808.00	6.00	$ 16,848.00	4.00	$ 11,232.00	4.00	$ 11,232.00	140.00	$ 393,120
10.07	Track structure: Tunnel												
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	0.08	$ 11,778.08	0.04	$ 5,889.04	0.21	$ 30,672.08	0.42	$ 61,344.17	0.97	$ 143,144
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	Track structure: Retaining walls and systems												
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.38	$ 14,820.76	-	$ -	0.76	$ 29,641.52	0.83	$ 32,371.66	2.48	$ 96,725
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -		$ -	0.21	$ 20,016.15	0.21	$ 20,016
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.06	$ 49,223.07	4.36	$ 42,440.24	4.00	$ 38,899.13	2.59	$ 25,256.78	27.81	$ 270,685
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	8.39	$ 226,706.19	4.64	$ 125,377.44	4.17	$ 112,587.50	1.61	$ 43,499.72	47.07	$ 1,271,969
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	0.38	$ 17,854.30	0.19	$ 8,927.15	-	$ -	-	$ -	1.33	$ 62,376
10.09	Track new construction: Conventional ballasted												
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	15.09	$ 48,650.21	9.32	$ 30,038.36	9.19	$ 29,605.21	5.70	$ 18,373.54	80.48	$ 259,401
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	8.28	$ 31,276.95	2.85	$ 10,770.15	4.55	$ 17,177.27	7.20	$ 27,197.35	74.74	$ 282,452
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	4.87	$ 24,350.000	8.41	$ 42,050.000	6.29	$ 31,450.000	2.20	$ 10,984.848	72.88	$ 364,376
10.10	Track new construction: Non-ballasted												
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	4.05	$ 15,304.95	5.72	$ 21,615.88	6.86	$ 25,909.05	1.59	$ 6,012.05	75.28	$ 284,495
10.18	Other linear structures including fencing, sound walls												
10.18.01	Highway Barrier Type 6	LF	$ 1.43	-	$ -	-	$ -	-	$ -	-	$ -	33,264.00	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	-	$ -	-	$ -	-	$ -	-	$ -	165,528.00	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	32.73	$ 7,241.51	26.25	$ 5,808.49	26.89	$ 5,949.41	16.67	$ 3,688.24	206.80	$ 45,754
	Sub-total Track Structures & Track (A)				$ 722,213.12		$ 619,321.03		$ 702,339.16		$ 337,837.29		$ 7,638,688
20 STATIONS, TERMINALS, INTERMODAL													
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	-	$ -	-	$ -	-	$ -	-	$ -	5.00	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	1.00	$ 25,000.000	-	$ -	-	$ -	7.00	$ 175,000
	Sub-total Stations, Terminals, Intermodal (B)				$ 25,000.00		$ 25,000.00		$ -		$ -		$ 425,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS													
30.02	Light maintenance facility												
30.02.01	Layover Facility	EA	$ 10,504	-	$ -	-	$ -	-	$ -	-	$ -	4.00	$ 42,016
30.03	Heavy maintenance facility												
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	1.00	$ 201,032
30.05	Yard and yard track												
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				$ -		$ -		$ -		$ -		$ 243,048
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS													
40.05	Site structures including retaining walls, sound walls												
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	-	$ -	-	$ -	-	$ -	1.00	$ 4,784.00	44.00	$ 210,496
40.07	Purchase or lease of real estate												
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	13,226,400.00	$ 145,490.40	4,164,336.00	$ 45,807.70	5,558,784.00	$ 61,146.62	-	$ -	45,880,440.00	$ 504,685
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	4,408,800.00	$ 96,993.60	2,776,224.00	$ 61,076.93	2,382,336.00	$ 52,411.39	-	$ -	38,066,232.00	$ 837,457
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				$ 242,484.00		$ 106,884.62		$ 113,558.02		$ 4,784.00		$ 1,552,638
50 COMMUNICATIONS & SIGNALING													
50.01	Wayside signaling equipment												
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	32.73	$ 70,369.50	26.29	$ 56,523.50	26.89	$ 57,813.50	16.67	$ 35,840.50	303.83	$ 653,226
	Sub-total Communications & Signaling (E)				$ 70,369.50		$ 56,523.50		$ 57,813.50		$ 35,840.50	-	$ 653,226
60 ELECTRIC TRACTION													
60.02	Traction power supply: Substations												
60.02.01	Traction Power Supply	Route Mile	$ 2,800	32.73	$ 91,644.00	26.29	$ 73,612.00	26.89	$ 75,292.00	16.67	$ 46,676.00	303.83	$ 850,713

See notes at bottom of page			Segment No.	Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6 -D1 Total	
	ICS: Denver Metro Capital Cost Estimate		From - To	I-25/US-85/E470 to I-70/C470		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
	Scenario A6-D1		Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield			
	Monday, June 24, 2013		Mileposts	N/A		N/A		N/A		N/A			
			Track Miles	32.7 miles		26.3 miles		26.9 miles		16.7 miles		303.8 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categoty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.03	**Traction power distribution: Catenary and third rail**												
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	32.73	$ 78,552.00	26.29	$ 63,096.00	26.89	$ 64,536.00	16.67	$ 40,008.00	**303.83**	$ 729,183
	Sub-total Electric Traction (F)				**$ 170,196.00**		**$ 136,708.00**		**$ 139,828.00**		**$ 86,684.00**		**$ 1,579,896**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 1,230,262.62		$ 944,437.15		$ 1,013,538.67		$ 465,145.79		$ 12,092,496
PROFESSIONAL SERVICES													
	Design Engineering	10%											
	Insurance and Bonding	2%											
	Program Management	4%											
	Construction Management & Inspection	6%											
	Engineering Services During Construction	2%											
	Integrated Testing and Commissioning	2%											
	Sub-total Professional Services (G)		26%		**$ 313,716.97**		**$ 240,831.47**		**$ 258,452.36**		**$ 118,612.18**		**$ 3,083,586**
UTILITY RELOCATION													
	Percentage of Route that is in Urban Areas			26%		40%		34%		19%		**52%**	
	Percentage of Route that is Outside of Urban Areas			74%		60%		66%		81%		**48%**	
	Through Urban Areas	6%	6%	8.35	$ 18,831.70	10.52	$ 22,666.49	9.02	$ 20,407.97	3.09	$ 5,165.71	**156.54**	$ 373,821
	Outside of Urban Areas	3%	3%	24.35	$ 27,458.20	15.77	$ 16,999.87	17.87	$ 20,206.70	13.58	$ 11,371.52	**147.24**	$ 175,797
	Sub-total Utility Relocation (H)				**$ 46,289.90**		**$ 39,666.36**		**$ 40,614.67**		**$ 16,537.23**		**$ 549,619**
ENVIRONMENTAL MITIGATION													
	Noise Mitigation	1%											
	Hazardous Waste	1%											
	Erosion Control	0.5%											
	Sub-total Environmental Mitigation (I)		2.5%		**$ 30,756.57**		**$ 23,610.93**		**$ 25,338.47**		**$ 11,628.64**		**$ 302,312**
CONTINGENCY													
	Design and Construction Contingency		30%		$ 486,307.816		$ 374,563.774		$ 401,383.251		$ 183,577.152		$ 4,808,404
2013 TOTAL SEGMENT COST (Sum A to J)				$ -	$ 2,107,333.87	$ -	$ 1,623,109.69	$ -	$ 1,739,327.42		$ 795,500.99	$ -	$ 20,836,417
	cost/mile (2013)			$ 64,385.39		$ 61,738.67		$ 64,683.06		$ 47,720.52		$ 68,577.83	

Scenerio A6-D1 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-3 segment and was removed from B-3 and B-4
2. E-470 to the north suburban station is carried on the B1 and removed from B4
3. Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4. Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
5. DIA station carried in E-3
6. North Suburban station carried in B1
7. South Suburban station carried in B-2
8. DUS carried in NS-1
9. 1-70/stockshow station carried on W-3
10. Golden station not included - is part of AGS Study
11. land acquisition modifications made for new corridor length to NS-1 and NS-2

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D2

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment NS-1		Segment NS-2	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		E470/I-76 to DUS		DUS to C470/US-85	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.83	$ 264,726.70	1.52	$ 83,051.52	2.31	$ 126,653.56	9.47	$ 519,071.97
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.11	$ 8,331.82	0.19	$ 13,886.36	0.21	$ 15,275.00	0.72	$ 52,768.18
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.49	$ 41,276.97	-	$ -	-	$ -	1.08	$ 90,491.82
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	14.00	$ 39,312.00	1.00	$ 2,808.00	10.00	$ 28,080.00	2.00	$ 5,616.00
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	-	$ -	0.27	$ 39,037.20	-	$ -	-	$ -
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.27	$ 10,341.44	-	$ -	-	$ -
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	0.11	$ 10,831.25	-	$ -	-	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	2.03	$ 19,726.10	1.50	$ 14,564.13	2.23	$ 21,754.02	0.80	$ 7,742.95
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	1.36	$ 36,846.82	1.31	$ 35,311.53	1.91	$ 51,687.90	0.72	$ 19,446.93
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.27	$ 12,458.14	0.30	$ 14,237.88	0.19	$ 8,898.67	0.19	$ 8,898.67
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	3.71	$ 11,964.17	3.49	$ 11,237.77	4.51	$ 14,527.92	1.61	$ 5,188.54
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	9.41	$ 35,544.79	9.15	$ 34,569.26	1.53	$ 5,797.33
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	8.45	$ 42,234.848	2.61	$ 13,068.182	-	$ -	-	$ -
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.92	$ 22,363.38	2.22	$ 8,373.92	2.42	$ 9,161.21	11.36	$ 42,943.18
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	18.08	$ 4,000.20	17.72	$ 3,920.55	16.10	$ 3,561.79	14.51	$ 3,209.80
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 503,241.15**		**$ 296,214.52**		**$ 314,169.33**		**$ 761,175.38**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	1.00	$ 50,000.00	-	$ -
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	1.00	$ 25,000.000	-	$ -	-	$ -	-	$ -
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 25,000.00		$ 50,000.00		$ 50,000.00		$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	9.00	$ 43,056.00	6.00	$ 28,704.00	2.00	$ 9,568.00	4.00	$ 19,136.00
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	375,587.20	$ 4,131.46	3,391,132.80	$ 37,302.46	2,550,000.00	$ 28,050.00	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	7,136,156.80	$ 156,995.45	2,774,563.20	$ 61,040.39	2,550,000.00	$ 56,100.00	4,596,000.00	$ 101,112.00
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 204,182.91**		**$ 127,046.85**		**$ 93,718.00**		**$ 120,248.00**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	18.08	$ 38,872.00	17.72	$ 38,098.00	16.10	$ 34,611.74	14.51	$ 31,191.29
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 38,872.00**		**$ 38,098.00**		**$ 34,611.74**		**$ 31,191.29**
60 ELECTRIC TRACTION															
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	18.08	$ 50,624.00	17.72	$ 49,616.00	16.10	$ 45,075.76	14.51	$ 40,621.21
60.03	**Traction power distribution: Catenary and third rail**														

See notes at bottom of page			Segment No.	Segment N-2		Segment S-3		Segment W5		Segment E5		Segment NS-1		Segment NS-2	
	ICS: Denver Metro Capital Cost Estimate		From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to 74th Avenue		74th Avenue to DIA		E470/I-76 to DUS		DUS to C470/US-85	
	Scenario A6-D2		Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield/Brush Line/ CML		CML/Joint Line/ Greenfield	
	Monday, June 24, 2013		Mileposts	0.0 miles		0.0 miles		N/A		N/A		0.0 miles		0.0 miles	
			Track Miles	39.7 miles		94.9 miles		18.1 miles		17.7 miles		16.1 miles		14.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Catetgory	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	18.08	$ 43,392.00	17.72	$ 42,528.00	16.10	$ 38,636.36	14.51	$ 34,818.18
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 94,016.00**		**$ 92,144.00**		**$ 83,712.12**		**$ 75,439.39**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 865,312.05		$ 603,503.37		$ 576,211.19		$ 988,054.07
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 220,654.57**		**$ 153,893.36**		**$ 146,933.85**		**$ 251,953.79**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		95%		45%		50%		100%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		5%		55%		50%		0%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	17.18	$ 49,322.79	7.97	$ 16,294.59	8.05	$ 17,286.34	14.51	$ 59,283.24
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	0.90	$ 1,297.97	9.75	$ 9,957.81	8.05	$ 8,643.17	-	$ -
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 50,620.76**		**$ 26,252.40**		**$ 25,929.50**		**$ 59,283.24**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 21,632.80**		**$ 15,087.58**		**$ 14,405.28**		**$ 24,701.35**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 347,466.056		$ 239,621.012		$ 229,043.949		$ 397,197.735
2013 TOTAL SEGMENT COST (Sum A to J)					$ 1,675,991.16		$ 6,879,341.36	$ -	$ 1,505,686.24	$ -	$ 1,038,357.72		$ 992,523.78		$ 1,721,190.18
	cost/mile (2013)			$ 42,184.52		$ 72,475.15		$ 83,279.11		$ 58,598.07		$ 61,653.24		$ 118,640.79	

Scenerio A6-D1 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the E-5 segment and was removed from B-3 and B-4
2 E-470 to the north suburban station is carried on the B1 and removed from B4
3 Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4 Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
5 DIA station carried in E-5
6 North Suburban station carried in B1
7 South Suburban station carried in B-2
8 DUS carried in NS-1
9 I-76/74th/RTD NM station carried on W-5
10 Golden station not included - is part of AGS Study
11 land acquisition modifications made for new corridor length to NS-1 and NS-2

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D2

Monday, June 24, 2013

Segment No.	Segment B1	Segment B2	Segment B3	Segment B4	Scenerio A6-D2 Total
From - To	I-25/US-85/E470 to I-70/C470	I-70/C470 to I-25/C470	I-25/C470 to DIA	DIA to I-25/US-85/E470	
Host Carrier	Greenfield	Greenfield	Greenfield	Greenfield	
Mileposts	N/A	N/A	N/A	N/A	
Track Miles	32.7 miles	26.3 miles	26.9 miles	16.7 miles	303.6 miles
	220.0 miles	220.0 miles	220.0 miles	220.0 miles	

FRA Standard Cost Categorty	Description	Unit	Final Costs (2013)	B1 Quantity	B1 Amount	B2 Quantity	B2 Amount	B3 Quantity	B3 Amount	B4 Quantity	B4 Amount	Total Quantity	Total Amount
10 TRACK STRUCTURES & TRACK													
10.01	**Track structure: Viaduct**												
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	4.49	$ 246,114.86	5.42	$ 297,091.88	6.63	$ 363,350.38	1.42	$ 77,860.80	**59.63**	$ 3,268,791
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	0.23	$ 16,863.60	0.17	$ 12,464.40	0.08	$ 5,865.60	-	$ -	**4.54**	$ 332,951
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.11	$ 9,220.64	-	$ -	-	$ -	-	$ -	**2.63**	$ 220,622
10.03	**Track structure: Undergrade Bridges**												
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	1.00	$ 2,808.00	6.00	$ 16,848.00	4.00	$ 11,232.00	4.00	$ 11,232.00	**142.00**	$ 398,736
10.07	**Track structure: Tunnel**												
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	0.08	$ 11,778.08	0.04	$ 5,889.04	0.21	$ 30,672.08	0.42	$ 61,344.17	**1.01**	$ 148,721
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.08	**Track structure: Retaining walls and systems**												
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.38	$ 14,820.76	-	$ -	0.76	$ 29,641.52	0.83	$ 32,371.66	**2.75**	$ 107,066
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -		$ -	0.21	$ 20,016.15	**0.32**	$ 30,847
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.06	$ 49,223.07	4.36	$ 42,440.24	4.00	$ 38,899.13	2.59	$ 25,256.78	**27.94**	$ 271,975
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	8.39	$ 226,706.19	4.64	$ 125,377.44	4.17	$ 112,587.50	1.61	$ 43,499.72	**47.32**	$ 1,278,621
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	0.38	$ 17,854.30	0.19	$ 8,927.15	-	$ -	-	$ -	**1.52**	$ 71,275
10.09	**Track new construction: Conventional ballasted**												
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	15.09	$ 48,650.21	9.32	$ 30,038.36	9.19	$ 29,605.21	5.70	$ 18,373.54	**81.72**	$ 263,375
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	8.28	$ 31,276.95	2.85	$ 10,770.15	4.55	$ 17,177.27	7.20	$ 27,197.35	**78.11**	$ 295,165
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	4.87	$ 24,350.000	8.41	$ 42,050.000	6.29	$ 31,450.000	2.20	$ 10,984.848	**72.12**	$ 360,588
10.10	**Track new construction: Non-ballasted**												
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	4.05	$ 15,304.95	5.72	$ 21,615.88	6.86	$ 25,909.05	1.59	$ 6,012.05	**71.24**	$ 269,211
10.18	**Other linear structures including fencing, sound walls**												
10.18.01	Highway Barrier Type 6	LF	$ 1.43	-	$ -	-	$ -	-	$ -	-	$ -	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	-	$ -	-	$ -	-	$ -	-	$ -	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	32.73	$ 7,241.51	26.25	$ 5,808.49	26.89	$ 5,949.41	16.67	$ 3,688.24	**206.60**	$ 45,710
	Sub-total Track Structures & Track (A)				**$ 722,213.12**		**$ 619,321.03**		**$ 702,339.16**		**$ 337,837.29**		**$ 7,447,638**
20 STATIONS, TERMINALS, INTERMODAL													
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	-	$ -	-	$ -	-	$ -	-	$ -	**5.00**	$ 250,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	1.00	$ 25,000.000	-	$ -	-	$ -	**7.00**	$ 175,000
	Sub-total Stations, Terminals, Intermodal (B)				$ 25,000.00		$ 25,000.00		$ -		$ -		**$ 425,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS													
30.02	**Light maintenance facility**												
30.02.01	Layover Facility	EA	$ 10,504	-	$ -	-	$ -	-	$ -	-	$ -	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**												
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	**1.00**	$ 201,032
30.05	**Yard and yard track**												
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ -**		**$ -**		**$ -**		**$ -**		**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS													
40.05	**Site structures including retaining walls, sound walls**												
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	-	$ -	-	$ -	-	$ -	1.00	$ 4,784.00	**43.00**	$ 205,712
40.07	**Purchase or lease of real estate**												
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	13,226,400.00	$ 145,490.40	4,164,336.00	$ 45,807.70	5,558,784.00	$ 61,146.62	-	$ -	**47,197,120.00**	$ 519,168
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	4,408,800.00	$ 96,993.60	2,776,224.00	$ 61,076.93	2,382,336.00	$ 52,411.39	-	$ -	**36,526,192.00**	$ 803,576
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 242,484.00**		**$ 106,884.62**		**$ 113,558.02**		**$ 4,784.00**		**$ 1,528,457**
50 COMMUNICATIONS & SIGNALING													
50.01	**Wayside signaling equipment**												
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	32.73	$ 70,369.50	26.29	$ 56,523.50	26.89	$ 57,813.50	16.67	$ 35,840.50	**303.63**	$ 652,796
	Sub-total Communications & Signaling (E)				**$ 70,369.50**		**$ 56,523.50**		**$ 57,813.50**		**$ 35,840.50**	**-**	**$ 652,796**
60 ELECTRIC TRACTION													
60.02	**Traction power supply: Substations**												
60.02.01	Traction Power Supply	Route Mile	$ 2,800	32.73	$ 91,644.00	26.29	$ 73,612.00	26.89	$ 75,292.00	16.67	$ 46,676.00	**303.63**	$ 850,153
60.03	**Traction power distribution: Catenary and third rail**												

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario A6-D2

Monday, June 24, 2013

			Segment No.	Segment B1		Segment B2		Segment B3		Segment B4		Scenerio A6-D2 Total	
			From - To	I-25/US-85/E470 to I-70/C470		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield			
			Mileposts	N/A		N/A		N/A		N/A			
			Track Miles	32.7 miles		26.3 miles		26.9 miles		16.7 miles		303.6 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	32.73	$ 78,552.00	26.29	$ 63,096.00	26.89	$ 64,536.00	16.67	$ 40,008.00	**303.63**	$ 728,703
	Sub-total Electric Traction (F)				**$ 170,196.00**		**$ 136,708.00**		**$ 139,828.00**		**$ 86,684.00**		**$ 1,578,856**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 1,230,262.62		$ 944,437.15		$ 1,013,538.67		$ 465,145.79		$ 11,875,794
PROFESSIONAL SERVICES													
	Design Engineering	10%											
	Insurance and Bonding	2%											
	Program Management	4%											
	Construction Management & Inspection	6%											
	Engineering Services During Construction	2%											
	Integrated Testing and Commissioning	2%											
	Sub-total Professional Services (G)		26%		**$ 313,716.97**		**$ 240,831.47**		**$ 258,452.36**		**$ 118,612.18**		**$ 3,028,328**
UTILITY RELOCATION													
	Percentage of Route that is in Urban Areas			26%		40%		34%		19%		**50%**	
	Percentage of Route that is Outside of Urban Areas			74%		60%		66%		81%		**50%**	
	Through Urban Areas	6%	6%	8.35	$ 18,831.70	10.52	$ 22,666.49	9.02	$ 20,407.97	3.09	$ 5,165.71	**152.49**	$ 357,860
	Outside of Urban Areas	3%	3%	24.35	$ 27,458.20	15.77	$ 16,999.87	17.87	$ 20,206.70	13.58	$ 11,371.52	**151.09**	$ 177,278
	Sub-total Utility Relocation (H)				**$ 46,289.90**		**$ 39,666.36**		**$ 40,614.67**		**$ 16,537.23**		**$ 535,138**
ENVIRONMENTAL MITIGATION													
	Noise Mitigation	1%											
	Hazardous Waste	1%											
	Erosion Control	0.5%											
	Sub-total Environmental Mitigation (I)		2.5%		**$ 30,756.57**		**$ 23,610.93**		**$ 25,338.47**		**$ 11,628.64**		**$ 296,895**
CONTINGENCY													
	Design and Construction Contingency		30%		$ 486,307.816		$ 374,563.774		$ 401,383.251		$ 183,577.152		**$ 4,720,846**
2013 TOTAL SEGMENT COST (Sum A to J)				$ -	$ 2,107,333.87	$ -	$ 1,623,109.69	$ -	$ 1,739,327.42		$ 795,500.99	$ -	$ 20,457,001
	cost/mile (2013)			$ 64,385.39		$ 61,738.67		$ 64,683.06		$ 47,720.52		$ 67,373.42	

Scenerio A6-D1 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the E-5 segment and was removed from B-3 and B-4
2. E-470 to the north suburban station is carried on the B1 and removed from B4
3. Joint Line and C-470 to I-25 was carried on B-2 and removed from NS-2
4. Hook at north end of NS-1 onto 470 alignment was carried on B-4 and removed from NS-1
5. DIA station carried in E-5
6. North Suburban station carried in B1
7. South Suburban station carried in B-2
8. DUS carried in NS-1
9. I-76/74th/RTD NM station carried on W-5
10. Golden station not included - is part of AGS Study
11. land acquisition modifications made for new corridor length to NS-1 and NS-2

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario B2A

Monday, June 24, 2013

				Segment N-2		Segment S-3		Segment B2		Segment B3		Segment B4	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		26.3 miles		26.9 miles		20.6 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK													
10.01	**Track structure: Viaduct**												
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	5.42	$ 297,091.88	6.63	$ 363,350.38	1.59	$ 87,154.26
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.17	$ 12,464.40	0.08	$ 5,865.60	-	$ -
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	-	$ -	-	$ -	-	$ -
10.03	**Track structure: Undergrade Bridges**												
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	6.00	$ 16,848.00	4.00	$ 11,232.00	5.00	$ 14,040.00
10.07	**Track structure: Tunnel**												
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	0.04	$ 5,889.04	0.21	$ 30,672.08	0.64	$ 94,804.62
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10.08	**Track structure: Retaining walls and systems**												
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.76	$ 29,641.52	0.83	$ 32,371.66
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -		$ -	0.21	$ 20,016.15
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	4.36	$ 42,440.24	4.00	$ 38,899.13	2.97	$ 28,909.98
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	4.64	$ 125,377.44	4.17	$ 112,587.50	1.74	$ 47,016.54
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.19	$ 8,927.15	-	$ -	-	$ -
10.09	**Track new construction: Conventional ballasted**												
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	9.32	$ 30,038.36	9.19	$ 29,605.21	6.17	$ 19,885.91
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	2.85	$ 10,770.15	4.55	$ 17,177.27	9.89	$ 37,374.31
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	8.41	$ 42,050.000	6.29	$ 31,450.000	2.44	$ 12,200.000
10.10	**Track new construction: Non-ballasted**												
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	5.72	$ 21,615.88	6.86	$ 25,909.05	2.06	$ 7,784.74
10.18	**Other linear structures including fencing, sound walls**												
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	26.25	$ 5,808.49	26.89	$ 5,949.41	19.93	$ 4,409.40
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 619,321.03**		**$ 702,339.16**		**$ 405,967.57**
20 STATIONS, TERMINALS, INTERMODAL													
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	-	$ -	1.00	$ 50,000.00
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	1.00	$ 25,000.000	-	$ -	1.00	$ 25,000.000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 25,000.00		$ -		$ 75,000.00
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS													
30.02	**Light maintenance facility**												
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -
30.03	**Heavy maintenance facility**												
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
30.05	**Yard and yard track**												
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS													
40.05	**Site structures including retaining walls, sound walls**												
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	-	$ -	-	$ -	1.00	$ 4,784.00
40.07	**Purchase or lease of real estate**												
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	4,164,336.00	$ 45,807.70	5,558,784.00	$ 61,146.62	-	$ -
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	2,776,224.00	$ 61,076.93	2,382,336.00	$ 52,411.39	-	$ -
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 106,884.62**		**$ 113,558.02**		**$ 4,784.00**
50 COMMUNICATIONS & SIGNALING													
50.01	**Wayside signaling equipment**												
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	26.29	$ 56,523.50	26.89	$ 57,813.50	20.57	$ 44,225.50

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario B2A

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment B2		Segment B3		Segment B4	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to I-25/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470	
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield	
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		N/A	
			Track Miles	39.7 miles		94.9 miles		26.3 miles		26.9 miles		20.6 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles	
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 56,523.50**		**$ 57,813.50**		**$ 44,225.50**
60 ELECTRIC TRACTION													
60.02	**Traction power supply: Substations**												
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	26.29	$ 73,612.00	26.89	$ 75,292.00	20.57	$ 57,596.00
60.03	**Traction power distribution: Catenary and third rail**												
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	26.29	$ 63,096.00	26.89	$ 64,536.00	20.57	$ 49,368.00
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 136,708.00**		**$ 139,828.00**		**$ 106,964.00**
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 978,556.34		$ 3,978,229.04		$ 944,437.15		$ 1,013,538.67		$ 636,941.07
PROFESSIONAL SERVICES													
	Design Engineering	10%											
	Insurance and Bonding	2%											
	Program Management	4%											
	Construction Management & Inspection	6%											
	Engineering Services During Construction	2%											
	Integrated Testing and Commissioning	2%											
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 240,831.47**		**$ 258,452.36**		**$ 162,419.97**
UTILITY RELOCATION													
	Percentage of Route that is in Urban Areas			25%		67%		40%		34%		15%	
	Percentage of Route that is Outside of Urban Areas			75%		33%		60%		66%		85%	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	10.52	$ 22,666.49	9.02	$ 20,407.97	3.09	$ 5,732.47
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	15.77	$ 16,999.87	17.87	$ 20,206.70	17.48	$ 16,242.00
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 39,666.36**		**$ 40,614.67**		**$ 21,974.47**
ENVIRONMENTAL MITIGATION													
	Noise Mitigation	1%											
	Hazardous Waste	1%											
	Erosion Control	0.5%											
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 23,610.93**		**$ 25,338.47**		**$ 15,923.53**
CONTINGENCY													
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 374,563.774		$ 401,383.251		$ 251,177.712
2013 TOTAL SEGMENT COST (Sum A to J)					$ 1,675,991.16		$ 6,879,341.36		$ 1,623,109.69		$ 1,739,327.42		$ 1,088,436.75
	cost/mile (2013)			$	42,184.52	$	72,475.15	$	61,738.67	$	64,683.06	$	52,913.79

Scenerio B2A Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the B4 segment and was removed from B3

2 North Suburban station carried in B-4

3 South Suburban station carried in B-2

4 DIA carried in B-4

5 Golden station not included - is part of AGS Study

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario B2A

Monday, June 24, 2013

Segment No.	Scenerio B2A Total
From - To	
Host Carrier	
Mileposts	
Track Miles	208.4 miles

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount
10 TRACK STRUCTURES & TRACK					
10.01	**Track structure: Viaduct**				
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	**37.19**	$ 2,038,466
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	**3.08**	$ 225,826
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	**0.95**	$ 79,633
10.03	**Track structure: Undergrade Bridges**				
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	**115.00**	$ 322,920
10.07	**Track structure: Tunnel**				
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	**0.89**	$ 131,366
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	**-**	$ -
10.08	**Track structure: Retaining walls and systems**				
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	**2.10**	$ 81,904
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	**0.21**	$ 20,016
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	**16.71**	$ 162,618
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	**33.76**	$ 912,139
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	**0.19**	$ 8,927
10.09	**Track new construction: Conventional ballasted**				
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	**53.78**	$ 173,319
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	**52.44**	$ 198,154
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	**56.43**	$ 282,150
10.10	**Track new construction: Non-ballasted**				
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	**45.74**	$ 172,837
10.18	**Other linear structures including fencing, sound walls**				
10.18.01	Highway Barrier Type 6	LF	$ 1.43	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	**110.72**	$ 24,497
	Sub-total Track Structures & Track (A)			**-**	**$ 4,918,755**
20 STATIONS, TERMINALS, INTERMODAL					
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	**4.00**	$ 200,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	**6.00**	$ 150,000
	Sub-total Stations, Terminals, Intermodal (B)				**$ 350,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS					
30.02	**Light maintenance facility**				
30.02.01	Layover Facility	EA	$ 10,504	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**				
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	**1.00**	$ 201,032
30.05	**Yard and yard track**				
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS					
40.05	**Site structures including retaining walls, sound walls**				
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	**22.00**	$ 105,248
40.07	**Purchase or lease of real estate**				
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	**27,654,000.00**	$ 304,194
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	**15,060,672.00**	$ 331,335
40.07.03	Relocation - Commercial	EA		**-**	$ -
40.07.04	Relocation - Residential	EA		**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 740,777**
50 COMMUNICATIONS & SIGNALING					
50.01	**Wayside signaling equipment**				
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	**208.39**	$ 448,039

See notes at bottom of page			Segment No.	Scenerio B2A Total	
ICS: Denver Metro Capital Cost Estimate			From - To		
Scenario B2A			Host Carrier		
Monday, June 24, 2013			Mileposts		
			Track Miles	208.4 miles	

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	Quantity	Amount
	Sub-total Communications & Signaling (E)			-	$ 448,039
60 ELECTRIC TRACTION					
60.02	**Traction power supply: Substations**				
60.02.01	Traction Power Supply	Route Mile	$ 2,800	**208.39**	$ 583,492
60.03	**Traction power distribution: Catenary and third rail**				
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	**208.39**	$ 500,136
	Sub-total Electric Traction (F)				$ 1,083,628
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 7,784,246
PROFESSIONAL SERVICES					
	Design Engineering	10%			
	Insurance and Bonding	2%			
	Program Management	4%			
	Construction Management & Inspection	6%			
	Engineering Services During Construction	2%			
	Integrated Testing and Commissioning	2%			
	Sub-total Professional Services (G)		26%		$ 1,984,983
UTILITY RELOCATION					
	Percentage of Route that is in Urban Areas			**46%**	
	Percentage of Route that is Outside of Urban Areas			**54%**	
	Through Urban Areas	6%	6%	**96.44**	$ 216,130
	Outside of Urban Areas	3%	3%	**111.94**	$ 125,433
	Sub-total Utility Relocation (H)				$ 341,563
ENVIRONMENTAL MITIGATION					
	Noise Mitigation	1%			
	Hazardous Waste	1%			
	Erosion Control	0.5%			
	Sub-total Environmental Mitigation (I)		2.5%		$ 194,606
CONTINGENCY					
	Design and Construction Contingency		30%		$ 3,091,619
2013 TOTAL SEGMENT COST (Sum A to J)					$ 13,397,018
	cost/mile (2013)			$	64,285.11

Scenerio B2A Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 E-470 to DIA is carried on the B4 segment and was removed from B3
2 North Suburban station carried in B-4
3 South Suburban station carried in B-2
4 DIA carried in B-4
5 Golden station not included - is part of AGS Study

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario B5

Monday, June 24, 2013

				Segment N-2		Segment S-3		Segment B1		Segment B3		Segment B4		Scenerio B5 Total	
			Segment No.	Segment N-2		Segment S-3		Segment B1		Segment B3		Segment B4		Scenerio B5 Total	
			From - To	in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-25/US-85/E470 to I-70/C470		I-25/C470 to DIA		DIA to I-25/US-85/E470			
			Host Carrier	Greenfield		Greenfield		Greenfield		Greenfield		Greenfield			
			Mileposts	0.0 miles		0.0 miles		N/A		N/A		N/A			
			Track Miles	39.7 miles		94.9 miles		33.4 miles		26.9 miles		20.6 miles		215.5 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Category	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK															
10.01	**Track structure: Viaduct**														
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	4.49	$ 246,114.86	6.63	$ 363,350.38	1.59	$ 87,154.26	**36.26**	$ 1,987,489
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.23	$ 16,863.60	0.08	$ 5,865.60	-	$ -	**3.14**	$ 230,225
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.11	$ 9,220.64	-	$ -	-	$ -	**1.06**	$ 88,853
10.03	**Track structure: Undergrade Bridges**														
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	2.00	$ 5,616.00	4.00	$ 11,232.00	5.00	$ 14,040.00	**111.00**	$ 311,688
10.07	**Track structure: Tunnel**														
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	0.08	$ 11,778.08	0.21	$ 30,672.08	0.64	$ 94,804.62	**0.93**	$ 137,255
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.08	**Track structure: Retaining walls and systems**														
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	0.38	$ 14,820.76	0.76	$ 29,641.52	0.83	$ 32,371.66	**2.48**	$ 96,725
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -		$ -	0.21	$ 20,016.15	**0.21**	$ 20,016
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	5.09	$ 49,546.06	4.00	$ 38,899.13	2.97	$ 28,909.98	**17.44**	$ 169,724
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	8.39	$ 226,706.19	4.17	$ 112,587.50	1.74	$ 47,016.54	**37.51**	$ 1,013,468
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	0.38	$ 17,854.30	-	$ -	-	$ -	**0.38**	$ 17,854
10.09	**Track new construction: Conventional ballasted**														
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	15.15	$ 48,828.45	9.19	$ 29,605.21	6.17	$ 19,885.91	**59.61**	$ 192,109
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	9.30	$ 35,144.70	4.55	$ 17,177.27	9.89	$ 37,374.31	**58.89**	$ 222,528
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	4.87	$ 24,350.000	6.29	$ 31,450.000	2.44	$ 12,200.000	**52.89**	$ 264,450
10.10	**Track new construction: Non-ballasted**														
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	4.05	$ 15,304.95	6.86	$ 25,909.05	2.06	$ 7,784.74	**44.07**	$ 166,526
10.18	**Other linear structures including fencing, sound walls**														
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	-	$ -	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	-	$ -	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	33.29	$ 7,366.22	26.89	$ 5,949.41	19.93	$ 4,409.40	**117.76**	$ 26,055
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 729,514.81**		**$ 702,339.16**		**$ 405,967.57**	**-**	**$ 5,028,949**
20 STATIONS, TERMINALS, INTERMODAL															
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	-	$ -	1.00	$ 50,000.00	**4.00**	$ 200,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	1.00	$ 25,000.000	1.00	$ 25,000.000	1.00	$ 25,000.000	**7.00**	$ 175,000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ 25,000.00		$ 25,000.00		$ 75,000.00		**$ 375,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS															
30.02	**Light maintenance facility**														
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	-	$ -	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**														
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	**1.00**	$ 201,032
30.05	**Yard and yard track**														
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ -**		**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS															
40.05	**Site structures including retaining walls, sound walls**														
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	-	$ -	-	$ -	1.00	$ 4,784.00	**22.00**	$ 105,248
40.07	**Purchase or lease of real estate**														
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	13,226,400.00	$ 145,490.40	5,558,784.00	$ 61,146.62	-	$ -	**36,716,064.00**	$ 403,877
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	4,408,800.00	$ 96,993.60	2,382,336.00	$ 52,411.39	-	$ -	**16,693,248.00**	$ 367,251
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 242,484.00**		**$ 113,558.02**		**$ 4,784.00**		**$ 876,376**
50 COMMUNICATIONS & SIGNALING															
50.01	**Wayside signaling equipment**														
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	33.37	$ 71,745.50	26.89	$ 57,813.50	20.57	$ 44,225.50	**215.47**	$ 463,261
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 71,745.50**		**$ 57,813.50**		**$ 44,225.50**	**-**	**$ 463,261**
60 ELECTRIC TRACTION															

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario B5

Monday, June 24, 2013

	Segment N-2	Segment S-3	Segment B1	Segment B3	Segment B4	Scenerio B5 Total
Segment No.	Segment N-2	Segment S-3	Segment B1	Segment B3	Segment B4	Scenerio B5 Total
From - To	in Fort Collins via I-25	E-470 @ I-25N to Pueblo Station	I-25/US-85/E470 to I-70/C470	I-25/C470 to DIA	DIA to I-25/US-85/E470	
Host Carrier	Greenfield	Greenfield	Greenfield	Greenfield	Greenfield	
Mileposts	0.0 miles	0.0 miles	N/A	N/A	N/A	
Track Miles	39.7 miles	94.9 miles	33.4 miles	26.9 miles	20.6 miles	215.5 miles
	220.0 miles	220.0 miles	220.0 miles	220.0 miles	220.0 miles	

FRA Standard Cost Category	Description	Unit	Final Costs (2013)	N-2 Quantity	N-2 Amount	S-3 Quantity	S-3 Amount	B1 Quantity	B1 Amount	B3 Quantity	B3 Amount	B4 Quantity	B4 Amount	Total Quantity	Total Amount
60.02	**Traction power supply: Substations**														
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	33.37	$ 93,436.00	26.89	$ 75,292.00	20.57	$ 57,596.00	**215.47**	$ 603,316
60.03	**Traction power distribution: Catenary and third rail**														
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	33.37	$ 80,088.00	26.89	$ 64,536.00	20.57	$ 49,368.00	**215.47**	$ 517,128
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 173,524.00**		**$ 139,828.00**		**$ 106,964.00**		**$ 1,120,444**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 978,556.34**		**$ 3,978,229.04**		**$ 1,242,268.31**		**$ 1,038,538.67**		**$ 636,941.07**		**$ 8,107,077**
PROFESSIONAL SERVICES															
	Design Engineering	10%													
	Insurance and Bonding	2%													
	Program Management	4%													
	Construction Management & Inspection	6%													
	Engineering Services During Construction	2%													
	Integrated Testing and Commissioning	2%													
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 316,778.42**		**$ 264,827.36**		**$ 162,419.97**		**$ 2,067,305**
UTILITY RELOCATION															
	Percentage of Route that is in Urban Areas			25%		67%		25%		34%		15%		**44%**	
	Percentage of Route that is Outside of Urban Areas			75%		33%		75%		66%		85%		**56%**	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	8.35	$ 18,634.02	9.02	$ 20,911.36	3.09	$ 5,732.47	**94.27**	$ 212,778
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	25.05	$ 27,951.04	17.87	$ 20,705.12	17.48	$ 16,242.00	**121.21**	$ 136,794
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 46,585.06**		**$ 41,616.47**		**$ 21,974.47**		**$ 349,572**
ENVIRONMENTAL MITIGATION															
	Noise Mitigation	1%													
	Hazardous Waste	1%													
	Erosion Control	0.5%													
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 31,056.71**		**$ 25,963.47**		**$ 15,923.53**		**$ 202,677**
CONTINGENCY															
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 491,006.551		$ 411,283.793		$ 251,177.712		**$ 3,217,989**
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**		**$ 2,127,695.05**		**$ 1,782,229.77**		**$ 1,088,436.75**		**$ 13,944,620**
	cost/mile (2013)				$ 42,184.52		$ 72,475.15		$ 63,703.44		$ 66,278.53		$ 52,913.79		$ 64,705.21

Scenerio B2A Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1. E-470 to DIA is carried on the B4 segment and was removed from B3
2. North Suburban station carried in B-4
3. South Suburban station carried in B-3
4. DIA carried in B-4
5. Golden station not included - is part of AGS Study

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate
Scenario C1
Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W1b		Segment B3		Scenerio C1 Total	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to RTD		I-25/C470 to DIA			
			Host Carrier	Greenfield		Greenfield		Greenfield/BNSF		Greenfield			
			Mileposts	0.0 miles		0.0 miles		0.0 miles		N/A			
			Track Miles	39.7 miles		94.9 miles		7.9 miles		30.1 miles		172.6 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
10 TRACK STRUCTURES & TRACK													
10.01	**Track structure: Viaduct**												
10.01.01	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile	54,814	2.21	$ 121,138.94	21.34	$ 1,169,730.76	0.57	$ 31,144.32	6.80	$ 372,735.20	**30.92**	$ 1,694,749
10.01.02	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile	73,320	-	$ -	2.83	$ 207,495.60	0.04	$ 2,777.27	0.08	$ 5,865.60	**2.95**	$ 216,138
10.01.03	Elevated Structure Straddle - 2 Track (30' Avg. Pier Ht)	Route Mile	83,824	0.20	$ 16,764.80	0.75	$ 62,868.00	0.49	$ 41,276.97	-	$ -	**1.44**	$ 120,910
10.03	**Track structure: Undergrade Bridges**												
10.03.01	Undergrade Bridge (Double Track)	EA	$ 2,808	23.00	$ 64,584.00	77.00	$ 216,216.00	6.00	$ 16,848.00	4.00	$ 11,232.00	**110.00**	$ 308,880
10.07	**Track structure: Tunnel**												
10.07.01	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc. Depth)	Route Mile	147,226	-	$ -	-	$ -	-	$ -	0.44	$ 64,779.44	**0.44**	$ 64,779
10.07.02	RH Double Track Tunnel 50ft ID in soft rock (poor)	Route Mile	360,776	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.08	**Track structure: Retaining walls and systems**												
10.08.01	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile	39,002	0.51	$ 19,891.02	-	$ -	-	$ -	0.76	$ 29,641.52	**1.27**	$ 49,533
10.08.02	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile	95,315	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.08.03	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile	9,734	5.38	$ 52,368.92	-	$ -	0.70	$ 6,821.17	4.34	$ 42,245.56	**10.42**	$ 101,436
10.08.04	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile	27,021	0.28	$ 7,565.88	22.93	$ 619,591.53	0.27	$ 7,164.66	4.30	$ 116,190.30	**27.78**	$ 750,512
10.08.05	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile	46,985	-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
10.09	**Track new construction: Conventional ballasted**												
10.09.01	Double Track New Construction on Prepared Subgrade	Route Mile	3,223	6.17	$ 19,885.91	22.93	$ 73,903.39	1.42	$ 4,562.86	9.60	$ 30,940.80	**40.12**	$ 129,293
10.09.02	Double Track New Construction on New Embankment	Route Mile	3,779	30.28	$ 114,428.12	4.87	$ 18,403.73	-	$ -	6.86	$ 25,923.94	**42.01**	$ 158,756
10.09.03	Double Track New Construction on Cut/Fill Roadbed (small ballast walls as needed)	Route Mile	5,000	-	$ -	39.29	$ 196,450.000	5.28	$ 26,420.455	6.29	$ 31,450.000	**50.86**	$ 254,320
10.10	**Track new construction: Non-ballasted**												
10.10.01	Double Track New Construction with Direct Fixation	Route Mile	3,779	3.27	$ 12,357.33	27.83	$ 105,169.57	1.21	$ 4,580.61	7.33	$ 27,700.07	**39.64**	$ 149,808
10.18	**Other linear structures including fencing, sound walls**												
10.18.01	Highway Barrier Type 6	LF	$ 1.43	33,264.00	$ 47,567.52	-	$ -	-	$ -	-	$ -	**33,264.00**	$ 47,568
10.18.02	Highway Barrier Type 5	LF	$ 0.22	165,528.00	$ 36,416.16	-	$ -	-	$ -	-	$ -	**165,528.00**	$ 36,416
10.18.03	Fencing, 10 ft Chain Link (both sides)	MI	$ 221.25	37.65	$ 8,330.06	-	$ -	7.91	$ 1,750.09	29.64	$ 6,558.88	**75.20**	$ 16,639
	Sub-total Track Structures & Track (A)				**$ 521,298.66**		**$ 2,669,828.58**		**$ 143,346.41**		**$ 765,263.31**		**$ 4,099,737**
20 STATIONS, TERMINALS, INTERMODAL													
20.01	Station buildings: Primary (incl 2000 parking spaces)	EA	$ 50,000.00	1.00	$ 50,000.00	2.00	$ 100,000.00	-	$ -	1.00	$ 50,000.00	**4.00**	$ 200,000
20.02	Station buildings: Secondary	EA	$ 25,000.00	1.00	$ 25,000.000	3.00	$ 75,000.000	-	$ -	1.00	$ 25,000.000	**5.00**	$ 125,000
	Sub-total Stations, Terminals, Intermodal (B)				$ 75,000.00		$ 175,000.00		$ -		$ 75,000.00		**$ 325,000**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS													
30.02	**Light maintenance facility**												
30.02.01	Layover Facility	EA	$ 10,504	1.00	$ 10,504.00	-	$ -	-	$ -	-	$ -	**4.00**	$ 42,016
30.03	**Heavy maintenance facility**												
30.03.01	Maintenance Facility (electrified track)	EA	$ 201,032	-	$ -	-	$ -	-	$ -	-	$ -	**1.00**	$ 201,032
30.05	**Yard and yard track**												
	Sub-total Support Facilities: Yards, Shops, Admin. Bldgs (C)				**$ 10,504.00**		**$ -**		**$ -**		**$ -**		**$ 243,048**
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS													
40.05	**Site structures including retaining walls, sound walls**												
40.05.01	Highway Bridge Over High Speed Rail	EA	$ 4,784	14.00	$ 66,976.00	7.00	$ 33,488.00	7.00	$ 33,488.00	-	$ -	**28.00**	$ 133,952
40.07	**Purchase or lease of real estate**												
40.07.01	Land Acquisition Rural	SQ FT	$ 0.011	1,166,880.00	$ 12,835.68	16,764,000.00	$ 184,404.00	543,283.20	$ 5,976.12	5,558,784.00	$ 61,146.62	**24,032,947.20**	$ 264,362
40.07.02	Land Acquisition Urban	SQ FT	$ 0.022	-	$ -	9,902,112.00	$ 217,846.46	3,078,604.80	$ 67,729.31	2,382,336.00	$ 52,411.39	**15,363,052.80**	$ 337,987
40.07.03	Relocation - Commercial	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
40.07.04	Relocation - Residential	EA		-	$ -	-	$ -	-	$ -	-	$ -	**-**	$ -
	Sub-total Sitework, Right of Way, Land, Existing Improvements (D)				**$ 79,811.68**		**$ 435,738.46**		**$ 107,193.42**		**$ 113,558.02**		**$ 736,302**
50 COMMUNICATIONS & SIGNALING													
50.01	**Wayside signaling equipment**												
50.01.01	Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone	Route Mile	$ 2,150	39.72	$ 85,398.00	94.92	$ 204,078.00	7.91	$ 17,006.50	30.08	$ 64,672.00	**172.63**	$ 371,155
	Sub-total Communications & Signaling (E)				**$ 85,398.00**		**$ 204,078.00**		**$ 17,006.50**		**$ 64,672.00**		**$ 371,155**

See notes at bottom of page

ICS: Denver Metro Capital Cost Estimate

Scenario C1

Monday, June 24, 2013

			Segment No.	Segment N-2		Segment S-3		Segment W1b		Segment B3		Scenerio C1 Total	
			From - To	E-470 @ I-25N to E. Prospect Avenue Sta in Fort Collins via I-25		E-470 @ I-25N to Pueblo Station		I-70/C470 to RTD		I-25/C470 to DIA			
			Host Carrier	Greenfield		Greenfield		Greenfield/BNSF		Greenfield			
			Mileposts	0.0 miles		0.0 miles		0.0 miles		N/A			
			Track Miles	39.7 miles		94.9 miles		7.9 miles		30.1 miles		172.6 miles	
				220.0 miles		220.0 miles		220.0 miles		220.0 miles			
FRA Standard Cost Categorty	**Description**	**Unit**	**Final Costs (2013)**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
60 ELECTRIC TRACTION													
60.02	**Traction power supply: Substations**												
60.02.01	Traction Power Supply	Route Mile	$ 2,800	39.72	$ 111,216.00	94.92	$ 265,776.00	7.91	$ 22,148.00	30.08	$ 84,224.00	**172.63**	$ 483,364
60.03	**Traction power distribution: Catenary and third rail**												
60.03.01	Traction Power Distribution Catenary	Route Mile	$ 2,400	39.72	$ 95,328.00	94.92	$ 227,808.00	7.91	$ 18,984.00	30.08	$ 72,192.00	**172.63**	$ 414,312
	Sub-total Electric Traction (F)				**$ 206,544.00**		**$ 493,584.00**		**$ 41,132.00**		**$ 156,416.00**		**$ 897,676**
	Sub-total Construction Elements (A+B+C+D+E+F)				**$ 978,556.34**		**$ 3,978,229.04**		**$ 308,678.33**		**$ 1,174,909.33**		**$ 6,672,917**
PROFESSIONAL SERVICES													
	Design Engineering	10%											
	Insurance and Bonding	2%											
	Program Management	4%											
	Construction Management & Inspection	6%											
	Engineering Services During Construction	2%											
	Integrated Testing and Commissioning	2%											
	Sub-total Professional Services (G)		26%		**$ 249,531.87**		**$ 1,014,448.41**		**$ 78,712.97**		**$ 299,601.88**		**$ 1,701,594**
UTILITY RELOCATION													
	Percentage of Route that is in Urban Areas			25%		67%		85%		30%		**52%**	
	Percentage of Route that is Outside of Urban Areas			75%		33%		15%		70%		**48%**	
	Through Urban Areas	6%	6%	9.93	$ 14,674.65	63.88	$ 160,642.00	6.72	$ 15,742.59	9.02	$ 21,148.37	**89.56**	$ 207,699
	Outside of Urban Areas	3%	3%	29.77	$ 21,997.20	31.04	$ 39,025.87	1.19	$ 1,389.05	21.06	$ 24,673.10	**83.05**	$ 96,303
	Sub-total Utility Relocation (H)				**$ 36,671.85**		**$ 199,667.87**		**$ 17,131.65**		**$ 45,821.46**		**$ 304,002**
ENVIRONMENTAL MITIGATION													
	Noise Mitigation	1%											
	Hazardous Waste	1%											
	Erosion Control	0.5%											
	Sub-total Environmental Mitigation (I)		2.5%		**$ 24,463.91**		**$ 99,455.73**		**$ 7,716.96**		**$ 29,372.73**		**$ 166,823**
CONTINGENCY													
	Design and Construction Contingency		30%		$ 386,767.190		$ 1,587,540.314		$ 123,671.972		$ 464,911.620		**$ 2,653,601**
2013 TOTAL SEGMENT COST (Sum A to J)					**$ 1,675,991.16**		**$ 6,879,341.36**		**$ 535,911.88**		**$ 2,014,617.02**		**$ 11,498,937**
	cost/mile (2013)				$ 42,184.52		$ 72,475.15		$ 67,751.19		$ 66,975.30		$ 66,606.45

Scenerio C1 Notes - Changes from Indepent segment estimates

All cells modified by these notes have been highlighted in:

1 South Suburban station carried in B-3

2 DIA station carried on B-3

3 Golden station not included - is part of AGS Study

Appendix C:

Part 1
CDOT Interregional Connectivity Study

Level 2 Service Plans

Appendix C – Part 1
CDOT Interregional Connectivity Study

Level 2 Service Plans

April 2013 Draft
(Revised May 15, 2013)

Prepared by:

1.0 Introduction

This paper documents the service plans developed for Level 2 alternatives carried forward in the Colorado Department of Transportation's (CDOT) Interregional Connectivity Study (ICS). Level 2 scenarios include the following:

- Concept A1: Direct routing through Denver, with the east-west corridor either using I-76 (A1a) or US-6 (A1b).
- Concept A5: Eastern Beltway, with the east-west corridor either using I-76 (A5a) or US-6 (A5b).
- Concept A6: Complete Beltway, with the east-west corridor either using I-76 (A6a) or US-6 (A6b).
- Concept B2A: Denver Periphery – Southwest (excludes northwest beltway).
- Concept C1: Shared Track with RTD.

Two concepts were later added for evaluation:

- Concept B5: Denver Periphery – Northwest (excludes southwest beltway).
- AGS Stand-Alone: Tests the I-70 corridor only, west of E-470.

Preliminary service plans were developed for each of these scenarios. For Level 2, the service plans were intended to define representative levels of rail service for use in ridership forecasting and developing general operating and maintenance (O&M) cost estimates.

2.0 General Service Considerations

Level 2 service plans used the following guidance:

- Service patterns were simplified as much as was practical. For example, rail service along the north-south corridor assumes all trains serve the full length from Fort Collins to Pueblo, rather than defining "short lines" (e.g., Fort Collins to Colorado Springs) as a method to provide additional coverage in the core segment. Assuming service along the full length of the line allows full potential to generate ridership; for Level 3, ridership results would be analyzed to refine service plans to tailor service levels to demand and maximize service efficiency.

- For the east-west corridor, service to Breckenridge is assumed to be a branch, rather than an in-line station to Eagle Airport. Thus, east-west trips are split on the west end so that while a majority of trips proceed to Eagle Airport, several trips instead serve the branch to Breckenridge. As the east-west corridor continues to be refined, this branch concept may be modified for Level 3.

- The service span for all high speed rail corridors is assumed to be 18 hours each day (e.g., 6am to midnight), seven days a week. For the north-south corridor, service is envisioned to follow a typical commute profile where more service is offered during weekday peak periods. For service related to the Mountain corridor, a different profile is anticipated: heavier service is likely to occur near the end of the week and on weekends, and lighter service occurs in the earlier weekdays.

- For the north-south and east-west corridors, a basic frequency of 24 round trips daily was assumed for days requiring heavier service. This amount of trips represents an 18-hour daily span (e.g., 6am to midnight), with 30 minute service in the peak period (3 hours in the morning and 3 hours in the afternoon) and hourly service for the remaining 12 hours.

- As a sensitivity test, a more aggressive level of service of 36 round trips daily was also defined. Still representing an 18-hour daily span, this level corresponds with 15 minute service in the six-hour peak period (split between am and pm) and hourly service for the remaining 12 hours. This level of service also supports the east-west capacity assumption of 4,900 passengers per hour and is therefore referred to as the capacity-based service plan.

- For scenarios where the north-south corridor meets the east-west corridor in the vicinity of DUS, I-76/72nd or DIA (e.g., Concepts A1 and A5), transfers are required between lines, as it is generally infeasible to have a train movement that turns off one corridor and onto the other at these locations.

- For scenarios using the Beltway (i.e., Concepts A6, B2A and B5), selected line patterns may directly connect part of a north-south corridor with part of an east-west corridor, e.g., Pueblo to Eagle Airport. In these cases, service in the trunk (common segment before service splits off) maintains the target round trips per day. The relative split of trips is generally advised by a preliminary ridership forecast using a complex service plan from the Rocky Mountain Rail Authority (RMRA) study, which provided direct service between numerous market combinations.

3.0 Level 2 Service Plans by Scenario

Based on the general guidelines outlined in the previous section, service plans were developed. Schematics of these service plans are provided at the end of this memorandum, and brief descriptions are provided below.

Concept A1: Direct routing through Denver, with the east-west corridor either using I-76 (A1a) or US-6 (A1b). This concept provides a single north-south pattern from Fort Collins to Pueblo. The east-west pattern proceeds from DIA to either Eagle Airport or Breckenridge.

- Basic Frequency Service Plan:
    - Fort Collins to Pueblo: 24 round trips daily

      Stations: Fort Collins, Berthoud, North Suburban, DUS, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
    - DIA to Eagle Airport: 21 round trips daily

      Stations: DIA, I-76/72nd (A1a) or DUS (A1b), West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
    - DIA to Breckenridge: 3 round trips daily

      Stations: DIA, I-76/72nd (A1a) or DUS (A1b), West Suburban, Georgetown, Silverthorne, Breckenridge

- Capacity-Based Service Plan (same stations as Basic Frequency Service Plan):
    - Fort Collins to Pueblo: 36 round trips daily
    - DIA to Eagle Airport: 30 round trips daily
    - DIA to Breckenridge: 6 round trips daily

For Concept A1a (east-west corridor via I-76), transferring from one high speed train to another is achieved by taking the North Metro line between DUS and I-76/72nd . For Concept A1b (east-west corridor via US-6), transfers between the two high speed rail lines can occur at DUS.

Concept A5: Eastern Beltway, with the east-west corridor either using I-76 (A5a) or US-6 (A5b). This concept provides a single north-south pattern from Fort Collins to Pueblo via the Eastern Beltway/DIA. The east-west pattern proceeds from DIA to either Eagle Airport or Breckenridge, either via I-76 (A5a) or US-6 (A5b).

- Basic Frequency Service Plan:
    - Fort Collins to Pueblo: 24 round trips daily

      Stations: Fort Collins, Berthoud, North Suburban, DIA, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
    - DIA to Eagle Airport: 21 round trips daily

      Stations: DIA, I-76/72nd (A5a) or DUS (A5b), West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
    - DIA to Breckenridge: 3 round trips daily

      Stations: DIA, I-76/72nd (A5a) or DUS (A5b), West Suburban, Georgetown, Silverthorne, Breckenridge

- Capacity-Based Service Plan (same stations as Basic Frequency Service Plan):
    - Fort Collins to Pueblo: 36 round trips daily
    - DIA to Eagle Airport: 30 round trips daily
    - DIA to Breckenridge: 6 round trips daily

Transfers between the two high speed rail lines can occur at DIA.

Concept A6: Complete Beltway. Direct routing through Denver is also assumed, with the east-west corridor either using I-76 (A6a) or US-6 (A6b).

This concept provides the most opportunities to provide direct train service between any two markets. However, the more patterns that are created, the more service is diluted, which may actually prove counterproductive in generating ridership. To isolate the most important markets to directly connect, the ridership forecast that was based on the RMRA operating plan was consulted since the RMRA operating plan involved a variety of train patterns between various market pairs.

Instead of developing a basic service plan and a separate capacity-based service plan, a single "balanced frequency" service plan was developed for this scenario. The intent was to provide enough service between enough markets to reasonably test the ridership potential. The Balanced Frequency Service Plan provides eight different service patterns:

- Fort Collins to Pueblo via DUS: 18 round trips daily

  Stations: Fort Collins, Berthoud, North Suburban, DUS, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- Fort Collins to Pueblo via DIA: 18 round trips daily

  Stations: Fort Collins, Berthoud, North Suburban, DIA, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
- DIA to Eagle Airport: 12 round trips daily

  Stations: DIA, I-76/72nd (A6a) or DUS (A6b), West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
- DIA to Breckenridge: 6 round trips daily

  Stations: DIA, I-76/72nd (A6a) or DUS (A6b), West Suburban, Georgetown, Silverthorne, Breckenridge
- Fort Collins to Eagle Airport: 12 round trips daily

  Stations: Fort Collins, Berthoud, North Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
- Fort Collins to Breckenridge: 6 round trips daily

  Stations: Fort Collins, Berthoud, North Suburban, West Suburban, Georgetown, Silverthorne, Breckenridge
- Pueblo to Eagle Airport: 12 round trips daily

  Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, Lone Tree, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
- Pueblo to Breckenridge: 6 round trips daily

  Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, Lone Tree, West Suburban, Georgetown, Silverthorne, Breckenridge

Trunk service (where several lines converge) can be as high as 54 round trips daily.

Transfer opportunities between the high speed rail lines occur at each of the major intercepts along the Beltway: North Suburban, DIA, Lone Tree and West Suburban. In addition, transfers can occur in Denver as described in Concept A1.

Concept B2A: Denver Periphery - Southwest. This scenario takes advantage of all but the northwest sector of the Beltway. Four different service patterns are defined, all using some portion of the Beltway.

- Basic Frequency Service Plan:
  - Fort Collins to Pueblo: 18 round trips daily

    Stations: Fort Collins, Berthoud, North Suburban, DIA, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
  - DIA to Eagle Airport: 12 round trips daily

    Stations: DIA, Lone Tree, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
  - Fort Collins to Breckenridge: 6 round trips daily

    Stations: Fort Collins, Berthoud, North Suburban, DIA, Lone Tree, West Suburban, Georgetown, Silverthorne, Breckenridge
  - Pueblo to Eagle Airport: 6 round trips daily

    Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, Lone Tree, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport

- Capacity-Based Service Plan (same stations as Basic Frequency Service Plan):
  - Fort Collins to Pueblo: 24 round trips daily
  - DIA to Eagle Airport: 12 round trips daily
  - Fort Collins to Breckenridge: 12 round trips daily
  - Pueblo to Eagle Airport: 12 round trips daily

Resulting trunk service levels are 24 round trips for the basic frequency service plan and 36 round trips for the capacity-based service plan, consistent with service levels defined for Concepts A1 and A5.

Transfers between high speed rail lines can occur at North Suburban, DIA, Lone Tree and West Suburban.

Concept C1: Shared Track with RTD. This scenario connects the Mountain Corridor with DIA via RTD's Gold Line and East Line. Fort Collins uses RTD's North Metro Line from the North Suburban station to DUS. The service pattern between Pueblo and DIA is the only one not dependent on sharing RTD track, as it uses the Beltway.

- Basic Frequency Service Plan:
    - Fort Collins to DUS: 24 round trips daily

      Stations: Fort Collins, Berthoud, North Suburban, DUS
    - DIA to Pueblo: 24 round trips daily

      Stations: DIA, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
    - DIA to Eagle Airport: 21 round trips daily

      Stations: DIA, DUS, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport

      DIA to Breckenridge: 3 round trips daily

      Stations: DIA, DUS, West Suburban, Georgetown, Silverthorne, Breckenridge

- Capacity-Based Service Plan (same stations as Basic Frequency Service Plan):
    - Fort Collins to DUS: 36 round trips daily
    - DIA to Pueblo: 36 round trips daily
    - DIA to Eagle Airport: 30 round trips daily
    - DIA to Breckenridge: 6 round trips daily

Transfers between the high speed rail lines can occur at DIA and DUS.

Concept B5: Denver Periphery – Northwest. This scenario takes advantage of all but the southwest sector of the Beltway. Four different service patterns are defined, all using some portion of the Beltway.

- Basic Frequency Service Plan:
    - Fort Collins to Pueblo: 18 round trips daily

      Stations: Fort Collins, Berthoud, North Suburban, DIA, Lone Tree, Castle Rock, Monument, Colorado Springs, Fort Carson, Pueblo
    - DIA to Eagle Airport: 12 round trips daily

      Stations: DIA, North Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
    - Fort Collins to Eagle Airport: 6 round trips daily

      Stations: Fort Collins, Berthoud, North Suburban, West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
    - Pueblo to Breckenridge: 6 round trips daily

      Stations: Pueblo, Fort Carson, Colorado Springs, Monument, Castle Rock, Lone Tree, DIA, North Suburban, West Suburban, Georgetown, Silverthorne, Breckenridge

Resulting trunk service levels are 24 round trips, consistent with basic service levels defined for Concepts A1 and A5.

Transfers between high speed rail lines can occur at DIA, North Suburban and West Suburban.

AGS Stand-Alone Concept: This concept was analyzed as a way of fully isolating the costs and ridership associated with the I-70 mountain corridor. This concept provides a single east-west pattern from the West Suburban station (I-70/E-470) to either Eagle Airport or Breckenridge.

- Basic Frequency Service Plan:
    - West Suburban to Eagle Airport: 21 round trips daily

      Stations: West Suburban, Georgetown, Silverthorne, Vail, Eagle Airport
    - West Suburban to Breckenridge: 3 round trips daily

      Stations: West Suburban, Georgetown, Silverthorne, Breckenridge

Resulting trunk service levels are 24 round trips, consistent with basic service defined for other concepts.

4.0 Level 2 Operating Statistics by Scenario

Based on the service plans described in Section 3, operating statistics were generated for each scenario. Operating statistics by scenario are presented after the service plan schematics.

Table 1 summarizes the operating characteristics for commute-type service generally assumed for the north-south corridor. Table 2 summarizes the operating characteristics for service related to the Mountain corridor.

Table 1
Commute Operating Characteristics

Day/Time Period	Hours	Example Time
Mon-Fri Peak Hr	6.0	6a-9a; 3p-6p
Mon-Fri Base Hour	6.0	9a-3p
Mon-Fri Eve Hour	6.0	6p-12a
Weekday Span	**18.0**	**6:00a-12:00a**
Sat Peak Hour	6.0	6a-9a; 3p-6p
Sat Base Hour	6.0	9a-3p
Sat Eve Hour	6.0	6p-12a
Saturday Span	**18.0**	**6:00a-12:00a**
Sun Peak Hour	6.0	6a-9a; 3p-6p
Sun Base Hour	6.0	9a-3p
Sun Eve Hour	6.0	6p-12a
Sunday/Holiday Span	**18.0**	**6:00a-12:00a**
Annual Mon-Fri	254	
Annual Sat	51	
Annual Sun & Holidays	60	
Annual Total	**365**	

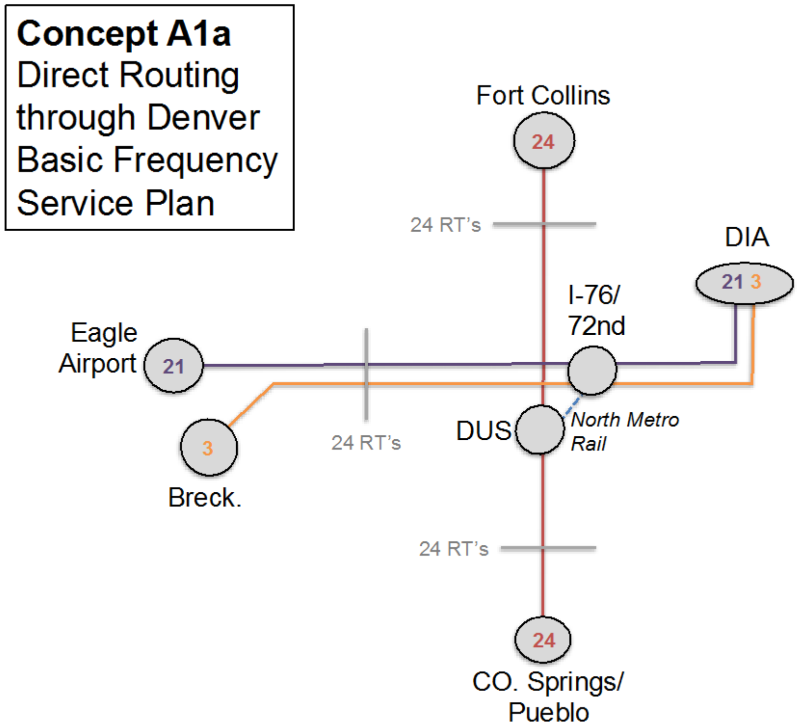
Table 2
Mountain Operating Characteristics

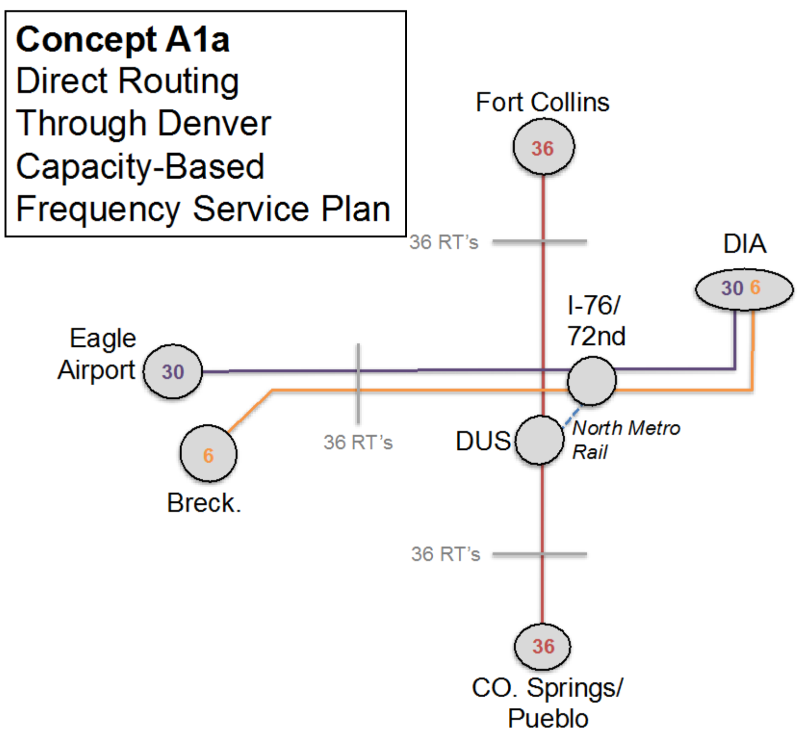
Day/Time Period	Hours	Example Time
Mon-Wed Peak Hr	6.0	6-9 am, 3-6 pm
Mon-Wed Base Hour	6.0	9 am-3 pm
Mon-Wed Eve Hour	6.0	6 pm-12 am
Monday-Wednesday Span	**18.0**	**6:00a-12:00a**
Thur-Fri Peak Hour	6.0	12 pm-6 pm
Thur-Fri Base Hour	6.0	6 am-12 pm
Thur-Fri Eve Hour	6.0	6 pm-12 am
Thursday-Friday Span	**18.0**	**6:00a-12:00a**
Sat-Sun Peak Hour	6.0	6-9 am, 3-6 pm
Sat-Sun Base Hour	6.0	6-8 am, 2-6 pm
Sat-Sun Eve Hour	6.0	6 pm-12 am
Santurday-Sunday Span	**18.0**	**6:00a-12:00a**
Annual Mon-Wed	156	
Annual Thur-Fri	104	
Annual Sat-Sun	105	
Annual Total	**365**	

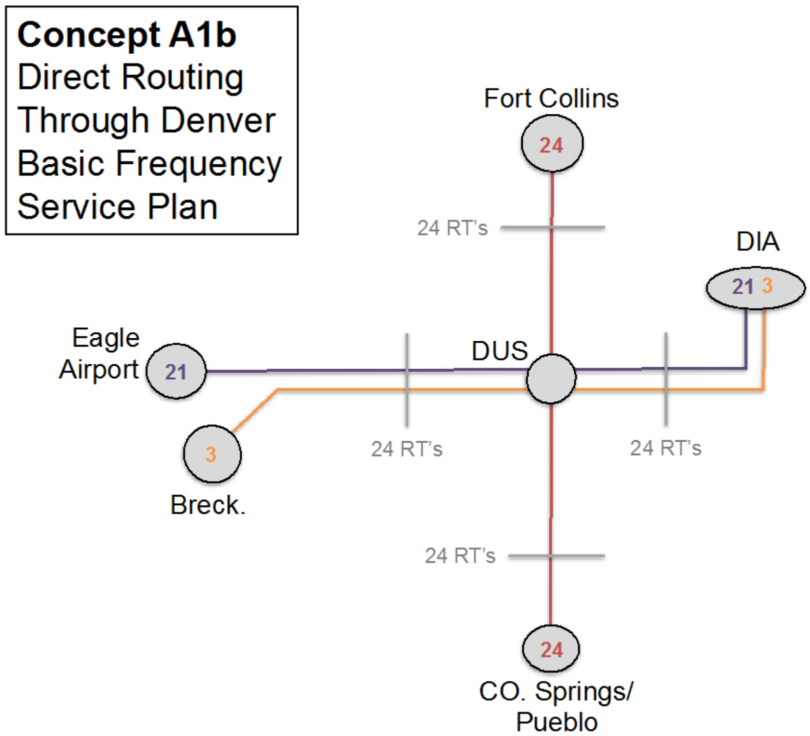
Runtimes and distances were provided by Aztec (Mountain corridor segment west of West Suburban station) and Quandel Consultants (all other segments). Table 3 summarizes the annual revenue train miles and train hours associated with each scenario.

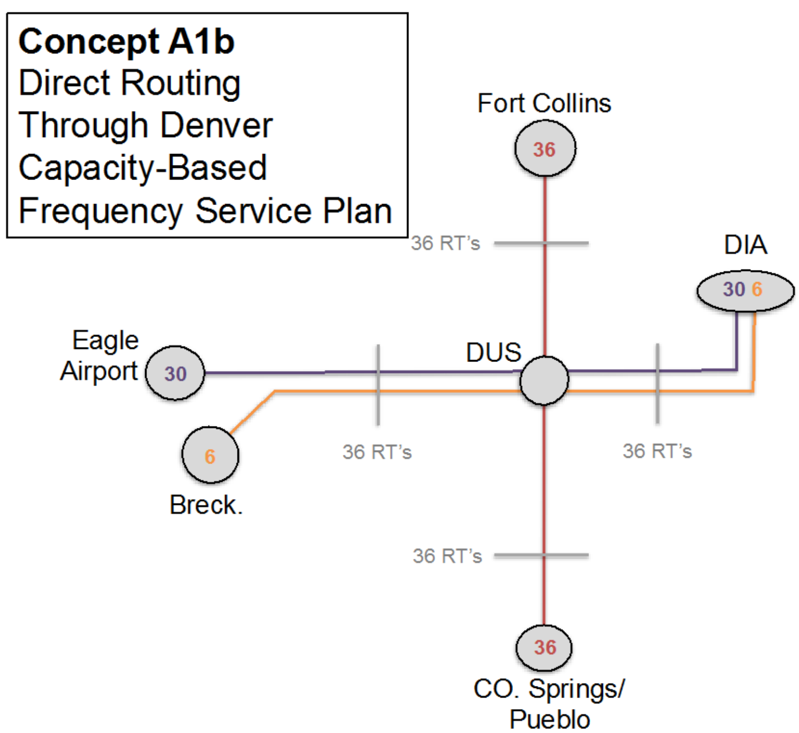
Table 3
Summary of Annual Revenue Train Miles and Annual Revenue Train Hours by Scenario

Concept		Service Plan	Annual Revenue Train-Miles	Annual Revenue Train-Hours
A1a	Direct Routing through Denver, E-W via I-76	Basic	5,086,300	71,770
A1a	Direct Routing through Denver, E-W via I-76	Capacity-Based	6,862,500	97,040
A1b	Direct Routing through Denver, E-W via US-6	Basic	5,095,700	71,770
A1b	Direct Routing through Denver, E-W via US-6	Capacity-Based	6,876,100	97,040
A5a	Eastern Beltway, E-W via I-76	Basic	5,146,500	71,770
A5a	Eastern Beltway, E-W via I-76	Capacity-Based	6,948,100	97,040
A5b	Eastern Beltway, E-W via US-6	Basic	5,155,900	71,770
A5b	Eastern Beltway, E-W via US-6	Capacity-Based	6,961,700	97,040
A6a	Complete Beltway, E-W via I-76	Balanced	10,738,600	147,805
A6b	Complete Beltway, E-W via US-6	Balanced	10,748,000	147,805
B2A	Denver Periphery Southwest	Basic	5,540,800	74,780
B2A	Denver Periphery Southwest	Capacity-Based	7,521,250	103,060
C1	Shared Track with RTD	Basic	5,208,280	83,546
C1	Shared Track with RTD	Capacity-Based	7,024,380	112,220
B5	Denver Periphery Northwest	Basic	5,557,800	74,780
AGS	Stand-Alone	Basic	1,486,600	22,380

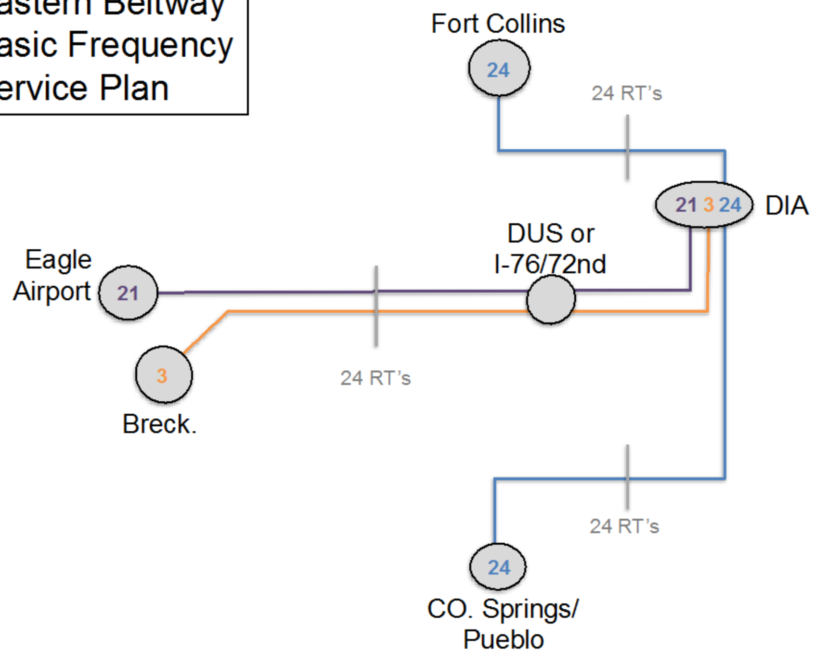

Concept A1a
Direct Routing
through Denver
Basic Frequency
Service Plan
Fort Collins
24
24 RT's
DIA
21 3
I-76/
72nd
Eagle
Airport
21
3
24 RT's
DUS
North Metro
Rail
Breck.
24 RT's
24
CO. Springs/
Pueblo


Concept A1a
Direct Routing
Through Denver
Capacity-Based
Frequency Service Plan
Fort Collins
36
36 RT's
DIA
30 6
I-76/
72nd
Eagle
Airport
30
6
36 RT's
DUS
North Metro
Rail
Breck.
36 RT's
36
CO. Springs/
Pueblo

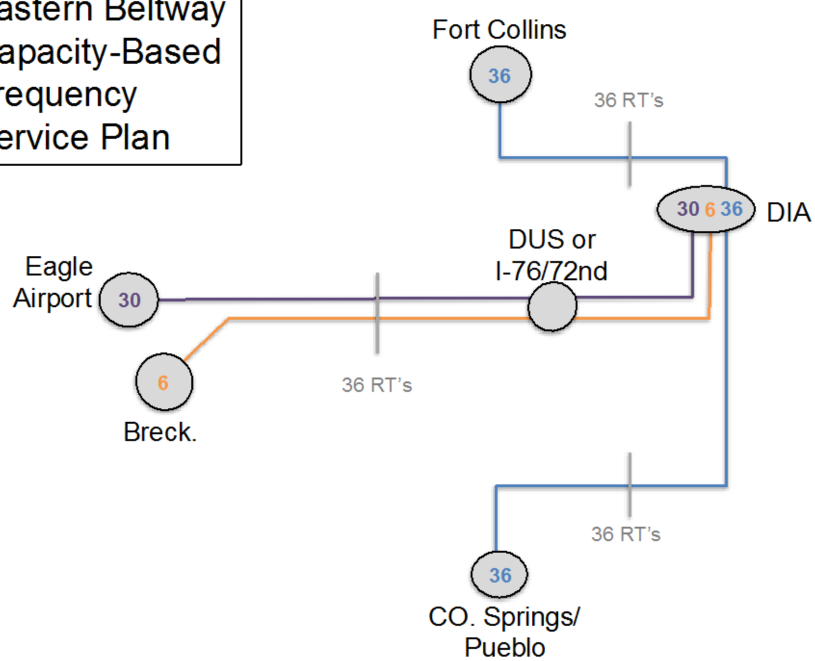

Concept A1b
Direct Routing
Through Denver
Basic Frequency
Service Plan
Fort Collins
24
24 RT's
DIA
21 3
Eagle
Airport
21
DUS
3
Breck.
24 RT's
24 RT's
24 RT's
24
CO. Springs/
Pueblo


Concept A1b
Direct Routing
Through Denver
Capacity-Based
Frequency Service Plan
Fort Collins
36
36 RT's
DIA
30 6
Eagle
Airport
30
DUS
6
Breck.
36 RT's
36 RT's
36 RT's
36
CO. Springs/
Pueblo

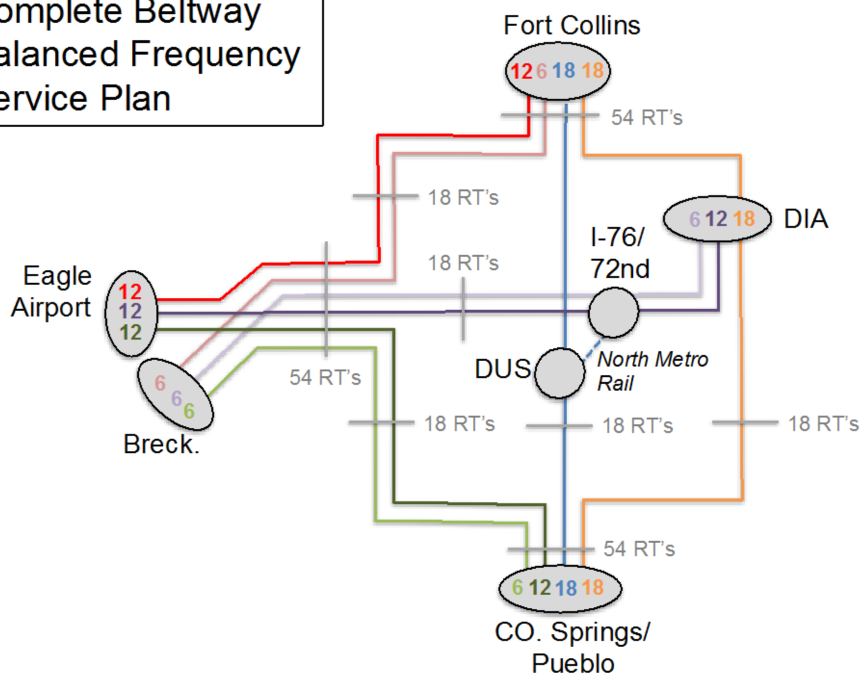
Concept A5
Eastern Beltway
Basic Frequency
Service Plan



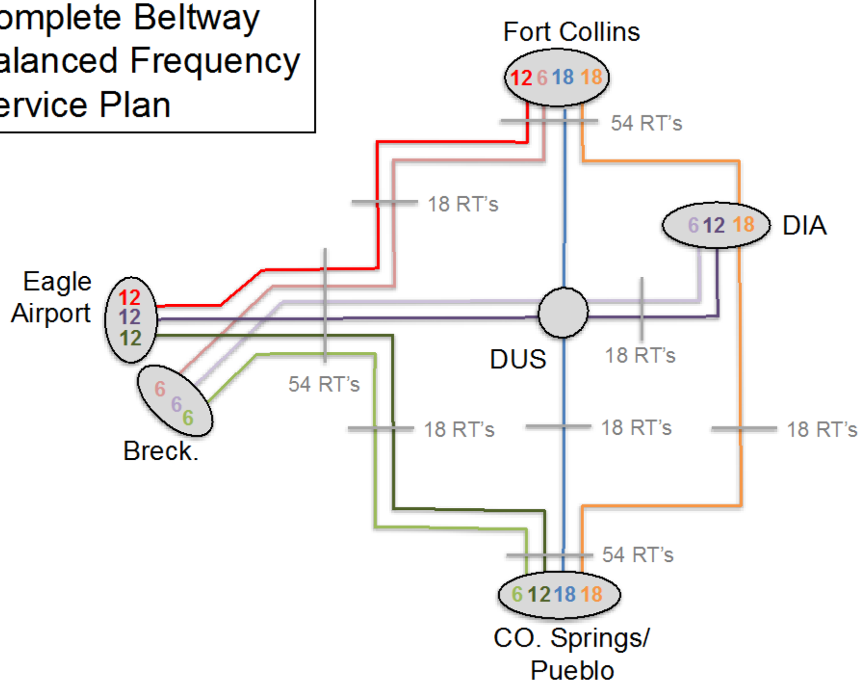
Concept A5
Eastern Beltway
Capacity-Based
Frequency
Service Plan



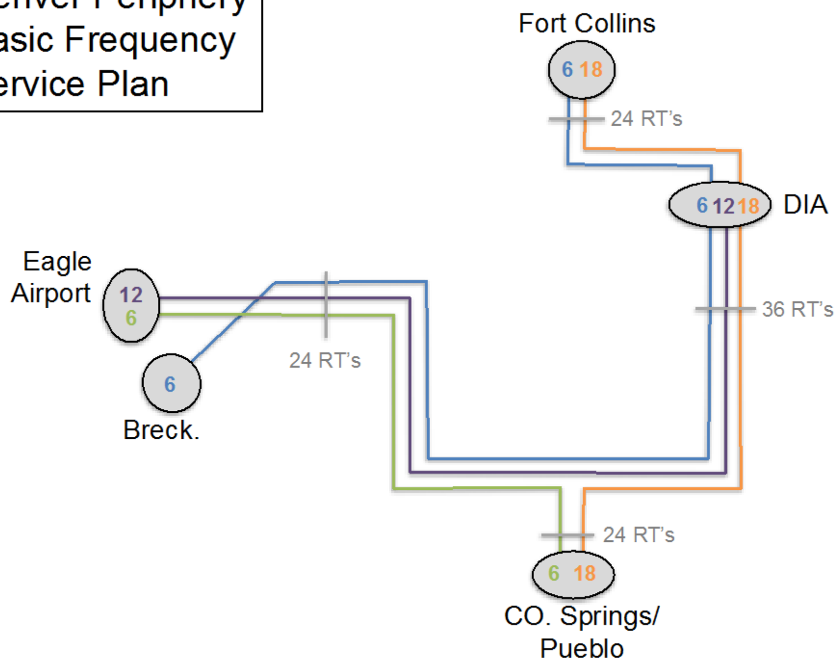
Concept A6a
Complete Beltway
Balanced Frequency
Service Plan



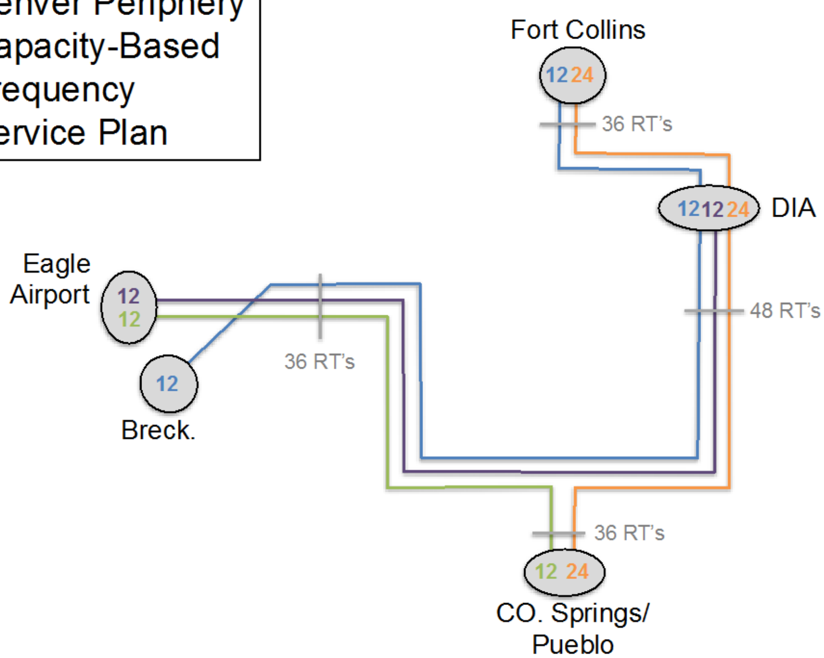
Concept A6b
Complete Beltway
Balanced Frequency
Service Plan

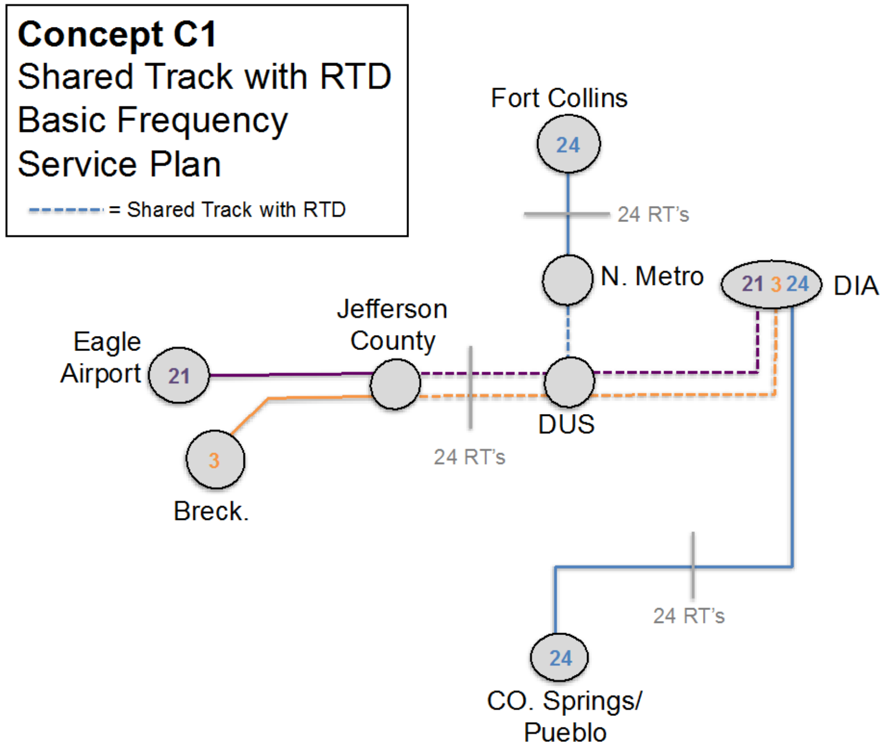


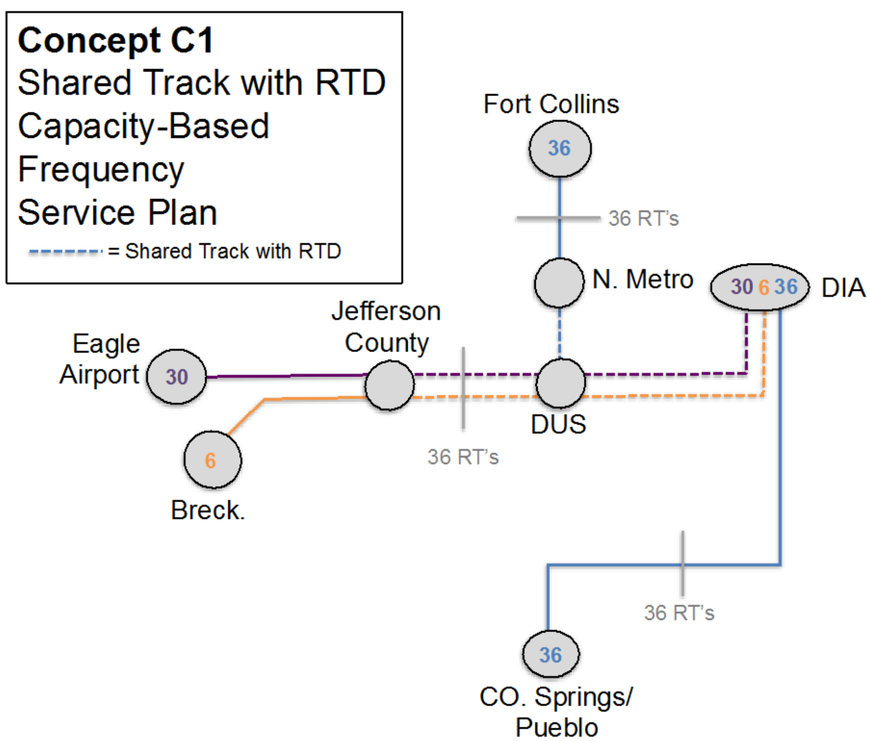
Concept B2A
Denver Periphery
Basic Frequency
Service Plan



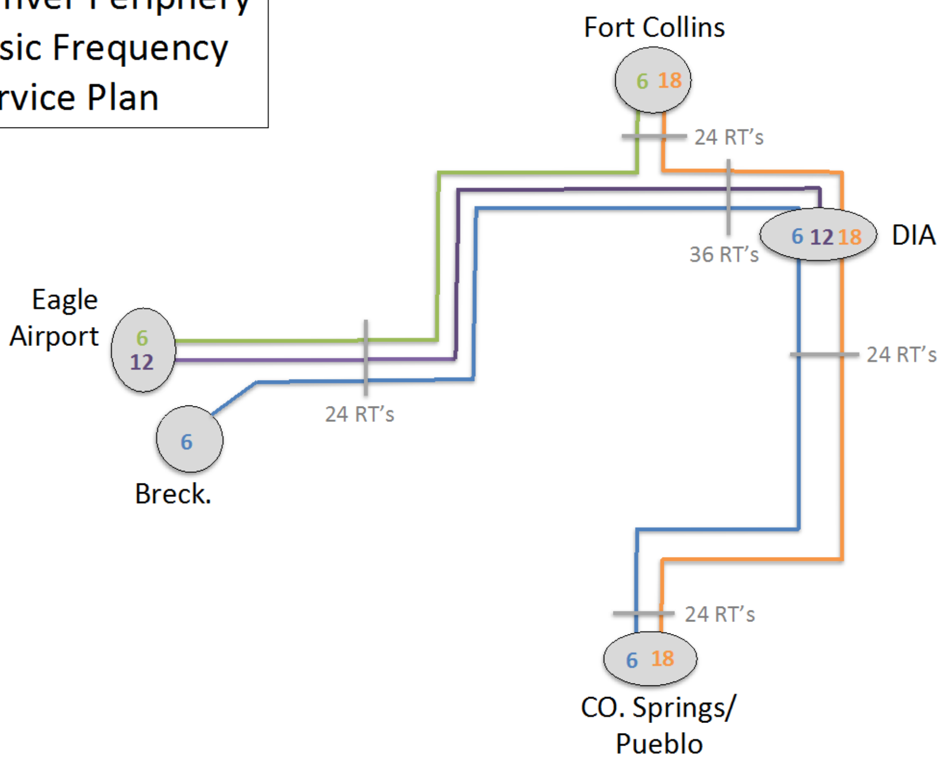
Concept B2A
Denver Periphery
Capacity-Based
Frequency
Service Plan



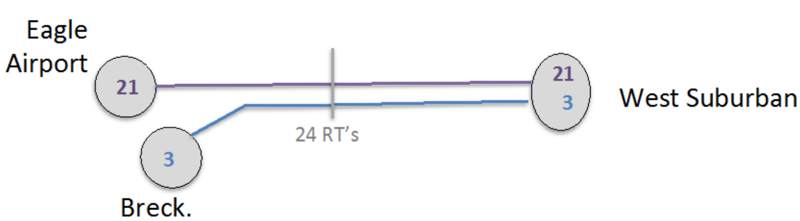

Concept C1
Shared Track with RTD
Basic Frequency
Service Plan
= Shared Track with RTD
Fort Collins
24
24 RT's
N. Metro
21 3 24
DIA
Jefferson
County
Eagle
Airport
21
DUS
3
Breck.
24 RT's
24 RT's
24
CO. Springs/
Pueblo


Concept C1
Shared Track with RTD
Capacity-Based
Frequency
Service Plan
= Shared Track with RTD
Fort Collins
36
36 RT's
N. Metro
30 6 36
DIA
Jefferson
County
Eagle
Airport
30
DUS
6
Breck.
36 RT's
36 RT's
36
CO. Springs/
Pueblo

Concept B5
Denver Periphery
Basic Frequency
Service Plan



AGS Stand-Alone



Concept A1a - Basic Frequency
Direct Routing Through Denver
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	30	60	60	24	10	9,010	120	2,288,500	30,480	10.0	5.0	5.0
via DUS				Sat	60	60	60	18		6,760	90	344,800	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,760	90	405,600	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**10**			**3,038,900**	**40,470**	**10.0**	**5.0**	**5.0**
DIA	Eagle Airport	95.0	136.62	M-W	60	60	120	15	8	4,100	60	639,600	9,360	4.0	4.0	2.0
via I-76				Th-Fr	30	60	120	21		5,740	84	597,000	8,740	8.0	4.0	2.0
				Sa-Su	30	60	120	21		5,740	84	602,700	8,820	8.0	4.0	2.0
DIA	Breckenridge	67.0	95.02	M-W	120	n/a	n/a	3	2	570	12	88,900	1,870	2.0	0.0	0.0
via I-76				Th-Fr	120	n/a	n/a	3		570	12	59,300	1,250	2.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		570	12	59,900	1,260	2.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**2,047,400**	**31,300**	**10.0**	**4.0**	**2.0**
SYSTEM TOTALS:									**20**			**5,086,300**	**71,770**	**20.0**	**9.0**	**7.0**
Front Range:									***13***			***3,599,400***	***48,490***	***13.0***	***6.0***	***5.0***
Mountains:		***(W. of JeffCo Stat.)***							***7***			***1,486,900***	***23,280***	***7.0***	***3.0***	***2.0***

Concept A1a - Capacity-Based Frequency
Direct Routing through Denver
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	15	60	60	36	20	13,510	180	3,431,500	45,720	20.0	5.0	5.0
via DUS				Sat	60	60	60	18		6,760	90	344,800	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,760	90	405,600	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**20**			**4,181,900**	**55,710**	**20.0**	**5.0**	**5.0**
DIA	Eagle Airport	95.0	136.62	M-W	60	60	120	15	12	4,100	60	639,600	9,360	4.0	4.0	2.0
via I-76				Th-Fr	20	60	60	30		8,200	120	852,800	12,480	12.0	4.0	4.0
				Sa-Su	20	60	60	30		8,200	120	861,000	12,600	12.0	4.0	4.0
DIA	Breckenridge	67.0	95.02	M-W	120	n/a	n/a	3	4	570	12	88,900	1,870	2.0	0.0	0.0
via I-76				Th-Fr	60	n/a	n/a	6		1,140	24	118,600	2,500	4.0	0.0	0.0
				Sa-Su	60	n/a	n/a	6		1,140	24	119,700	2,520	4.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**16**			**2,680,600**	**41,330**	**16.0**	**4.0**	**4.0**
SYSTEM TOTALS:									**36**			**6,862,500**	**97,040**	**36.0**	**9.0**	**9.0**
Front Range:									***24***			***4,922,100***	***66,410***	***24.0***	***6.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***12***			***1,940,400***	***30,630***	***12.0***	***3.0***	***3.0***

Concept A1b - Basic Frequency
Direct Routing through Denver
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	30	60	60	24	10	9,010	120	2,288,500	30,480	10.0	5.0	5.0
via DUS				Sat	60	60	60	18		6,760	90	344,800	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,760	90	405,600	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**10**			**3,038,900**	**40,470**	**10.0**	**5.0**	**5.0**
DIA	Eagle Airport	97.0	137.36	M-W	60	60	120	15	8	4,120	60	642,700	9,360	4.0	4.0	2.0
via US 6				Th-Fr	30	60	120	21		5,770	84	600,100	8,740	8.0	4.0	2.0
				Sa-Su	30	60	120	21		5,770	84	605,900	8,820	8.0	4.0	2.0
DIA	Breckenridge	69.0	95.76	M-W	120	n/a	n/a	3	2	570	12	88,900	1,870	2.0	0.0	0.0
via US 6				Th-Fr	120	n/a	n/a	3		570	12	59,300	1,250	2.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		570	12	59,900	1,260	2.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**2,056,800**	**31,300**	**10.0**	**4.0**	**2.0**
SYSTEM TOTALS:									**20**			**5,095,700**	**71,770**	**20.0**	**9.0**	**7.0**
Front Range:									***13***			***3,610,200***	***49,000***	***13.0***	***6.0***	***6.0***
Mountains:	***(W. of JeffCo Stat.)***								***7***			***1,485,500***	***22,770***	***7.0***	***3.0***	***1.0***

Concept A1b - Capacity-Based Frequency
Direct Routing through Denver
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	15	60	60	36	20	13,510	180	3,431,500	45,720	20.0	5.0	5.0
via DUS				Sat	60	60	60	18		6,760	90	344,800	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,760	90	405,600	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**20**			**4,181,900**	**55,710**	**20.0**	**5.0**	**5.0**
DIA	Eagle Airport	97.0	137.36	M-W	60	60	120	15	12	4,120	60	642,700	9,360	4.0	4.0	2.0
via US 6				Th-Fr	20	60	60	30		8,240	120	857,000	12,480	12.0	4.0	4.0
				Sa-Su	20	60	60	30		8,240	120	865,200	12,600	12.0	4.0	4.0
DIA	Breckenridge	69.0	95.76	M-W	120	n/a	n/a	3	4	570	12	88,900	1,870	2.0	0.0	0.0
via US 6				Th-Fr	60	n/a	n/a	6		1,150	24	119,600	2,500	4.0	0.0	0.0
				Sa-Su	60	n/a	n/a	6		1,150	24	120,800	2,520	4.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**16**			**2,694,200**	**41,330**	**16.0**	**4.0**	**4.0**
SYSTEM TOTALS:									**36**			**6,876,100**	**97,040**	**36.0**	**9.0**	**9.0**
Front Range:									***25***			***4,936,900***	***67,080***	***25.0***	***6.0***	***6.0***
Mountains:	***(W. of JeffCo Stat.)***								***11***			***1,939,200***	***29,960***	***11.0***	***3.0***	***3.0***

Concept A5a - Basic Frequency
Eastern Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	30	60	60	24	10	9,190	120	2,334,300	30,480	10.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**10**			**3,099,100**	**40,470**	**10.0**	**5.0**	**5.0**
DIA	Eagle Airport	95.0	136.62	M-W	60	60	120	15	8	4,100	60	639,600	9,360	4.0	4.0	2.0
via I-76				Th-Fr	30	60	120	21		5,740	84	597,000	8,740	8.0	4.0	2.0
				Sa-Su	30	60	120	21		5,740	84	602,700	8,820	8.0	4.0	2.0
DIA	Breckenridge	67.0	95.02	M-W	120	n/a	n/a	3	2	570	12	88,900	1,870	2.0	0.0	0.0
via I-76				Th-Fr	120	n/a	n/a	3		570	12	59,300	1,250	2.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		570	12	59,900	1,260	2.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**2,047,400**	**31,300**	**10.0**	**4.0**	**2.0**
SYSTEM TOTALS:									**20**			**5,146,500**	**71,770**	**20.0**	**9.0**	**7.0**
Front Range:									***13***			***3,659,600***	***48,490***	***13.0***	***6.0***	***5.0***
Mountains:		***(W. of JeffCo Stat.)***							***7***			***1,486,900***	***23,280***	***7.0***	***3.0***	***2.0***

Concept A5a - Capacity-Based Frequency
Eastern Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	15	60	60	36	20	13,790	180	3,502,700	45,720	20.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**20**			**4,267,500**	**55,710**	**20.0**	**5.0**	**5.0**
DIA	Eagle Airport	95.0	136.62	M-W	60	60	120	15	12	4,100	60	639,600	9,360	4.0	4.0	2.0
via I-76				Th-Fr	20	60	60	30		8,200	120	852,800	12,480	12.0	4.0	4.0
				Sa-Su	20	60	60	30		8,200	120	861,000	12,600	12.0	4.0	4.0
DIA	Breckenridge	67.0	95.02	M-W	120	n/a	n/a	3	4	570	12	88,900	1,870	2.0	0.0	0.0
via I-76				Th-Fr	60	n/a	n/a	6		1,140	24	118,600	2,500	4.0	0.0	0.0
				Sa-Su	60	n/a	n/a	6		1,140	24	119,700	2,520	4.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**16**			**2,680,600**	**41,330**	**16.0**	**4.0**	**4.0**
SYSTEM TOTALS:									**36**			**6,948,100**	**97,040**	**36.0**	**9.0**	**9.0**
Front Range:									***24***			***5,007,700***	***66,410***	***24.0***	***6.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***12***			***1,940,400***	***30,630***	***12.0***	***3.0***	***3.0***

Concept A5b - Basic Frequency
Eastern Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	30	60	60	24	10	9,190	120	2,334,300	30,480	10.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**10**			**3,099,100**	**40,470**	**10.0**	**5.0**	**5.0**
DIA	Eagle Airport	97.0	137.36	M-W	60	60	120	15	8	4,120	60	642,700	9,360	4.0	4.0	2.0
via US-6				Th-Fr	30	60	120	21		5,770	84	600,100	8,740	8.0	4.0	2.0
				Sa-Su	30	60	120	21		5,770	84	605,900	8,820	8.0	4.0	2.0
DIA	Breckenridge	69.0	95.76	M-W	120	n/a	n/a	3	2	570	12	88,900	1,870	2.0	0.0	0.0
via US-6				Th-Fr	120	n/a	n/a	3		570	12	59,300	1,250	2.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		570	12	59,900	1,260	2.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**2,056,800**	**31,300**	**10.0**	**4.0**	**2.0**
SYSTEM TOTALS:									**20**			**5,155,900**	**71,770**	**20.0**	**9.0**	**7.0**
Front Range:									***13***			***3,670,400***	***49,000***	***13.0***	***6.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***7***			***1,485,500***	***22,770***	***7.0***	***3.0***	***1.0***

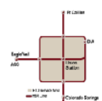
Concept A5b - Capacity-Based Frequency
Eastern Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	15	60	60	36	20	13,790	180	3,502,700	45,720	20.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**20**			**4,267,500**	**55,710**	**20.0**	**5.0**	**5.0**
DIA	Eagle Airport	97.0	137.36	M-W	60	60	120	15	12	4,120	60	642,700	9,360	4.0	4.0	2.0
via US-6				Th-Fr	20	60	60	30		8,240	120	857,000	12,480	12.0	4.0	4.0
				Sa-Su	20	60	60	30		8,240	120	865,200	12,600	12.0	4.0	4.0
DIA	Breckenridge	69.0	95.76	M-W	120	n/a	n/a	3	4	570	12	88,900	1,870	2.0	0.0	0.0
via US-6				Th-Fr	60	n/a	n/a	6		1,150	24	119,600	2,500	4.0	0.0	0.0
				Sa-Su	60	n/a	n/a	6		1,150	24	120,800	2,520	4.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**16**			**2,694,200**	**41,330**	**16.0**	**4.0**	**4.0**
SYSTEM TOTALS:									**36**			**6,961,700**	**97,040**	**36.0**	**9.0**	**9.0**
Front Range:									***25***			***5,022,500***	***67,080***	***25.0***	***6.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***11***			***1,939,200***	***29,960***	***11.0***	***3.0***	***3.0***

Concept A6a - Balanced Plan
Complete Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	60	60	60	18	5	6,760	90	1,717,000	22,860	5.0	5.0	5.0
via DUS				Sat	60	60	120	15		5,630	75	287,100	3,830	5.0	5.0	2.5
				Sun	60	60	120	15		5,630	75	337,800	4,500	5.0	5.0	2.5
Ft. Collins	Pueblo	121.0	191.47	M-F	60	60	60	18	5	6,890	90	1,750,060	22,860	5.0	5.0	5.0
via DIA				Sat	60	60	120	15		5,740	75	292,740	3,825	5.0	5.0	2.5
				Sun	60	60	120	15		5,740	75	344,400	4,500	5.0	5.0	2.5
FRONT RANGE LINE TOTALS:									**10**			**4,729,100**	**62,375**	**10.0**	**10.0**	**10.0**
DIA	Eagle Airport	95.0	136.62	M-W	120	120	120	9	4	2,460	36	383,800	5,620	2.0	2.0	2.0
via I-76				Th-Fr	60	120	120	12		3,280	48	341,100	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		3,280	48	344,400	5,040	4.0	2.0	2.0
DIA	Breckenridge	67.0	95.02	M-W	120	120	n/a	6	2	1,140	24	177,800	3,740	2.0	2.0	0.0
via I-76				Th-Fr	120	120	n/a	6		1,140	24	118,600	2,500	2.0	2.0	0.0
				Sa-Su	120	120	n/a	6		1,140	24	119,700	2,520	2.0	2.0	0.0
Ft. Collins	Eagle Airport	120.0	178.05	M-W	120	120	120	9	4	3,200	36	499,200	5,620	2.0	2.0	2.0
				Th-Fr	60	120	120	12		4,270	48	444,100	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		4,270	48	448,400	5,040	4.0	2.0	2.0
Ft. Collins	Breckenridge	92.0	136.45	M-W	120	120	n/a	6	2	1,640	24	255,800	3,740	2.0	2.0	0.0
				Th-Fr	120	120	n/a	6		1,640	24	170,600	2,500	2.0	2.0	0.0
				Sa-Su	120	120	n/a	6		1,640	24	172,200	2,520	2.0	2.0	0.0
Pueblo	Eagle Airport	152.0	222.61	M-W	120	120	120	9	6	4,010	54	625,600	8,420	3.0	3.0	3.0
				Th-Fr	60	120	120	12		5,340	72	555,400	7,490	6.0	3.0	3.0
				Sa-Su	60	120	120	12		5,340	72	560,700	7,560	6.0	3.0	3.0
Pueblo	Breckenridge	124.0	181.01	M-W	120	120	n/a	6	3	2,170	36	338,500	5,620	3.0	3.0	0.0
				Th-Fr	120	120	n/a	6		2,170	36	225,700	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,170	36	227,900	3,780	3.0	3.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**21**			**6,009,500**	**85,430**	**21.0**	**14.0**	**7.0**
SYSTEM TOTALS:									**31**			**10,738,600**	**147,805**	**31.0**	**24.0**	**17.0**
Front Range:									***19***			***7,594,700***	***100,835***	***19.0***	***17.0***	***13.0***
Mountains:		***(W. of JeffCo Stat.)***							***12***			***3,143,900***	***46,970***	***12.0***	***7.0***	***4.0***

Concept A6b - Balanced Plan
Complete Beltway
220 mph Max. Speed Scenario



From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	120.0	187.66	M-F	60	60	60	18	5	6,760	90	1,717,000	22,860	5.0	5.0	5.0
via DUS				Sat	60	60	120	15		5,630	75	287,100	3,830	5.0	5.0	2.5
				Sun	60	60	120	15		5,630	75	337,800	4,500	5.0	5.0	2.5
Ft. Collins	Pueblo	121.0	191.47	M-F	60	60	60	18	5	6,890	90	1,750,060	22,860	5.0	5.0	5.0
via DIA				Sat	60	60	120	15		5,740	75	292,740	3,825	5.0	5.0	2.5
				Sun	60	60	120	15		5,740	75	344,400	4,500	5.0	5.0	2.5
FRONT RANGE LINE TOTALS:									**10**			**4,729,100**	**62,375**	**10.0**	**10.0**	**10.0**
DIA	Eagle Airport	97.0	137.36	M-W	120	120	120	9	4	2,470	36	385,300	5,620	2.0	2.0	2.0
via US-36				Th-Fr	60	120	120	12		3,300	48	343,200	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		3,300	48	346,500	5,040	4.0	2.0	2.0
DIA	Breckenridge	69.0	95.76	M-W	120	120	n/a	6	2	1,150	24	179,400	3,740	2.0	2.0	0.0
via US-36				Th-Fr	120	120	n/a	6		1,150	24	119,600	2,500	2.0	2.0	0.0
				Sa-Su	120	120	n/a	6		1,150	24	120,800	2,520	2.0	2.0	0.0
Ft. Collins	Eagle Airport	120.0	178.05	M-W	120	120	120	9	4	3,200	36	499,200	5,620	2.0	2.0	2.0
				Th-Fr	60	120	120	12		4,270	48	444,100	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		4,270	48	448,400	5,040	4.0	2.0	2.0
Ft. Collins	Breckenridge	92.0	136.45	M-W	120	120	n/a	6	2	1,640	24	255,800	3,740	2.0	2.0	0.0
				Th-Fr	120	120	n/a	6		1,640	24	170,600	2,500	2.0	2.0	0.0
				Sa-Su	120	120	n/a	6		1,640	24	172,200	2,520	2.0	2.0	0.0
Pueblo	Eagle Airport	152.0	222.61	M-W	120	120	120	9	6	4,010	54	625,600	8,420	3.0	3.0	3.0
				Th-Fr	60	120	120	12		5,340	72	555,400	7,490	6.0	3.0	3.0
				Sa-Su	60	120	120	12		5,340	72	560,700	7,560	6.0	3.0	3.0
Pueblo	Breckenridge	124.0	181.01	M-W	120	120	n/a	6	3	2,170	36	338,500	5,620	3.0	3.0	0.0
				Th-Fr	120	120	n/a	6		2,170	36	225,700	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,170	36	227,900	3,780	3.0	3.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**21**			**6,018,900**	**85,430**	**21.0**	**14.0**	**7.0**
SYSTEM TOTALS:									**31**			**10,748,000**	**147,805**	**31.0**	**24.0**	**17.0**
Front Range:									***19***			***7,603,900***	***101,245***	***19.0***	***17.0***	***13.0***
Mountains:		***(W. of JeffCo Stat.)***							***12***			***3,144,100***	***46,560***	***12.0***	***7.0***	***4.0***

Concept B2A - Basic Frequency
Denver Periphery
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	60	60	60	18	5	6,890	90	1,750,100	22,860	5.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**5**			**2,514,900**	**32,850**	**5.0**	**5.0**	**5.0**
DIA	Eagle Airport	112.0	159.80	M-W	120	120	120	9	4	2,880	36	449,300	5,620	2.0	2.0	2.0
via South Suburban				Th-Fr	60	120	120	12		3,840	48	399,400	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		3,840	48	403,200	5,040	4.0	2.0	2.0
Pueblo	Eagle Airport	152.0	222.61	M-W	120	120	n/a	6	3	2,670	36	416,500	5,620	3.0	3.0	0.0
				Th-Fr	120	120	n/a	6		2,670	36	277,700	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,670	36	280,400	3,780	3.0	3.0	0.0
Ft. Collins	Breckenridge	121.0	182.64	M-W	120	120	n/a	6	3	2,190	36	341,600	5,620	3.0	3.0	0.0
via DIA				Th-Fr	120	120	n/a	6		2,190	36	227,800	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,190	36	230,000	3,780	3.0	3.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**3,025,900**	**41,930**	**10.0**	**8.0**	**2.0**
SYSTEM TOTALS:									**15**			**5,540,800**	**74,780**	**15.0**	**13.0**	**7.0**
Front Range:									***10***			***4,050,500***	***66,460***	***10.0***	***9.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***5***			***1,490,300***	***8,320***	***5.0***	***4.0***	***1.0***

Concept B2A - Capacity-Based Frequency
Denver Periphery
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	30	60	60	24	10	9,190	120	2,334,260	30,480	10.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,390	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**10**			**3,099,050**	**40,470**	**10.0**	**5.0**	**5.0**
DIA	Eagle Airport	112.0	159.80	M-W	120	120	120	9	4	2,880	36	449,300	5,620	2.0	2.0	2.0
via South Suburban				Th-Fr	60	120	120	12		3,840	48	399,400	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		3,840	48	403,200	5,040	4.0	2.0	2.0
Pueblo	Eagle Airport	152.0	222.61	M-W	120	120	120	9	6	4,010	54	625,600	8,420	3.0	3.0	3.0
				Th-Fr	60	120	120	12		5,340	72	555,400	7,490	6.0	3.0	3.0
				Sa-Su	60	120	120	12		5,340	72	560,700	7,560	6.0	3.0	3.0
Ft. Collins	Breckenridge	121.0	182.64	M-W	120	120	120	9	6	3,290	54	513,200	8,420	3.0	3.0	3.0
via DIA				Th-Fr	60	120	120	12		4,380	72	455,500	7,490	6.0	3.0	3.0
				Sa-Su	60	120	120	12		4,380	72	459,900	7,560	6.0	3.0	3.0
MOUNTAIN CORRIDOR LINE TOTALS:									**16**			**4,422,200**	**62,590**	**16.0**	**8.0**	**8.0**
SYSTEM TOTALS:									**26**			**7,521,250**	**103,060**	**26.0**	**13.0**	**13.0**
Front Range:									***18***			***5,479,650***	***92,400***	***18.0***	***9.0***	***9.0***
Mountains:		***(W. of JeffCo Stat.)***							***8***			***2,041,600***	***10,660***	***8.0***	***4.0***	***4.0***

Concept C1 - Basic Frequency
Shared Track with RTD
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	DUS	49.0	62.37	M-F	30	60	60	24	4	2,990	48	759,460	12,192	4.0	2.0	2.0
				Sat	60	60	60	18		2,250	36	114,750	1,836	2.0	2.0	2.0
				Sun	60	60	60	18		2,250	36	135,000	2,160	2.0	2.0	2.0
DIA	Pueblo	82.0	127.03	M-F	30	60	60	24	7	6,100	84	1,549,400	21,336	7.0	4.0	4.0
				Sat	60	60	60	18		4,570	72	233,070	3,672	4.0	4.0	4.0
				Sun	60	60	60	18		4,570	72	274,200	4,320	4.0	4.0	4.0
FRONT RANGE LINE TOTALS:									**11**			**3,065,880**	**45,516**	**11.0**	**6.0**	**6.0**
DIA	Eagle Airport	128.0	142.52	M-W	60	60	120	15	10	4,280	75	667,700	11,700	5.0	5.0	3.0
				Th-Fr	30	60	120	21		5,990	105	623,000	10,920	10.0	5.0	3.0
				Sa-Su	30	60	120	21		5,990	105	629,000	11,030	10.0	5.0	3.0
DIA	Breckenridge	100.0	100.92	M-W	120	n/a	n/a	3	2	610	12	95,200	1,870	2.0	0.0	0.0
				Th-Fr	120	n/a	n/a	3		610	12	63,400	1,250	2.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		610	12	64,100	1,260	2.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**12**			**2,142,400**	**38,030**	**12.0**	**5.0**	**3.0**
SYSTEM TOTALS:									**23**			**5,208,280**	**83,546**	**23.0**	**11.0**	**9.0**
Front Range:									***16***			***3,719,780***	***62,686***	***16.0***	***8.0***	***7.0***
Mountains:		*(W. of JeffCo Stat.)*							***7***			***1,488,500***	***20,860***	***7.0***	***3.0***	***2.0***

Concept C1 - Capacity-Based Frequency
Shared Track with RTD
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	DUS	49.0	62.37	M-F	15	60	60	36	8	4,490	72	1,140,460	18,288	8.0	2.0	2.0
				Sat	60	60	60	18		2,250	36	114,750	1,836	2.0	2.0	2.0
				Sun	60	60	60	18		2,250	36	135,000	2,160	2.0	2.0	2.0
DIA	Pueblo	82.0	127.03	M-F	15	60	60	36	14	9,150	126	2,324,100	32,004	14.0	4.0	4.0
				Sat	60	60	60	18		4,570	72	233,070	3,672	4.0	4.0	4.0
				Sun	60	60	60	18		4,570	72	274,200	4,320	4.0	4.0	4.0
FRONT RANGE LINE TOTALS:									**22**			**4,221,580**	**62,280**	**22.0**	**6.0**	**6.0**
DIA	Eagle Airport	128.0	142.52	Th-M	60	60	120	15	15	4,280	75	667,700	11,700	5.0	5.0	3.0
				Tu	20	60	60	30		8,550	150	889,200	15,600	15.0	5.0	5.0
				W	20	60	60	30		8,550	150	897,800	15,750	15.0	5.0	5.0
DIA	Breckenridge	100.0	100.92	Th-M	120	n/a	n/a	3	4	610	12	95,200	1,870	2.0	0.0	0.0
				Tu	60	n/a	n/a	6		1,210	24	125,800	2,500	4.0	0.0	0.0
				W	60	n/a	n/a	6		1,210	24	127,100	2,520	4.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**19**			**2,802,800**	**49,940**	**19.0**	**5.0**	**5.0**
SYSTEM TOTALS:									**41**			**7,024,380**	**112,220**	**41.0**	**11.0**	**11.0**
Front Range:									***31***			***5,083,880***	***84,970***	***31.0***	***8.0***	***8.0***
Mountains:		*(W. of JeffCo Stat.)*							***10***			***1,940,500***	***27,250***	***10.0***	***3.0***	***3.0***

Concept B5 - Basic Frequency
Denver Periphery using NW Beltway
220 mph Max. Speed Scenario

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
Ft. Collins	Pueblo	121.0	191.47	M-F	60	60	60	18	5	6,890	90	1,750,100	22,860	5.0	5.0	5.0
via DIA				Sat	60	60	60	18		6,890	90	351,400	4,590	5.0	5.0	5.0
				Sun	60	60	60	18		6,890	90	413,400	5,400	5.0	5.0	5.0
FRONT RANGE LINE TOTALS:									**5**			**2,514,900**	**32,850**	**5.0**	**5.0**	**5.0**
DIA	Eagle Airport	109.0	154.75	M-W	120	120	120	9	4	2,790	36	435,200	5,620	2.0	2.0	2.0
via North Suburban				Th-Fr	60	120	120	12		3,710	48	385,800	4,990	4.0	2.0	2.0
				Sa-Su	60	120	120	12		3,710	48	389,600	5,040	4.0	2.0	2.0
Ft. Collins	Eagle Airport	120.0	178.05	M-W	120	120	n/a	6	3	2,140	36	333,800	5,620	3.0	3.0	0.0
				Th-Fr	120	120	n/a	6		2,140	36	222,600	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,140	36	224,700	3,780	3.0	3.0	0.0
Pueblo	Breckenridge	165.0	240.18	M-W	120	120	n/a	6	3	2,880	36	449,300	5,620	3.0	3.0	0.0
via DIA				Th-Fr	120	120	n/a	6		2,880	36	299,500	3,740	3.0	3.0	0.0
				Sa-Su	120	120	n/a	6		2,880	36	302,400	3,780	3.0	3.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**10**			**3,042,900**	**41,930**	**10.0**	**8.0**	**2.0**
SYSTEM TOTALS:									**15**			**5,557,800**	**74,780**	**15.0**	**13.0**	**7.0**
Front Range:									***10***			***4,067,800***	***53,050***	***10.0***	***9.0***	***6.0***
Mountains:		***(W. of JeffCo Stat.)***							***5***			***1,490,000***	***21,730***	***5.0***	***4.0***	***1.0***

AGS Stand-Alone

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve	Round Trips	Max. Trains	Daily Train-Mi's.	Daily Train-Hrs	Annual Train-Mi's.	Annual Train-Hrs	Daily Trains Peak	Daily Trains Base	Daily Trains Eve
West Suburban	Eagle Airport	72.0	100.81	M-W	60	60	120	15	6	3,020	45	471,100	7,020	3.0	3.0	1.5
				Th-Fr	30	60	120	21		4,230	63	439,900	6,550	6.0	3.0	1.5
				Sa-Su	30	60	120	21		4,230	63	444,200	6,620	6.0	3.0	1.5
West Suburban	Breckenridge	44.0	59.21	M-W	120	n/a	n/a	3	1	360	6	56,200	940	1.0	0.0	0.0
				Th-Fr	120	n/a	n/a	3		360	6	37,400	620	1.0	0.0	0.0
				Sa-Su	120	n/a	n/a	3		360	6	37,800	630	1.0	0.0	0.0
MOUNTAIN CORRIDOR LINE TOTALS:									**7**			**1,486,600**	**22,380**	**7.0**	**3.0**	**1.5**

Appendix C:

Part 2
CDOT Interregional Connectivity Study

Level 2 Operating & Maintenance Cost Estimates

Appendix C – Part 2

CDOT Interregional Connectivity Study

Level 2 Operating & Maintenance Cost Estimates

April 2013 Draft
(revised May 15, 2013)

Prepared by:

1.0 Introduction

This paper describes the methodology and resulting estimates of Level 2 operating and maintenance (O&M) costs for the Colorado Department of Transportation's (CDOT) Interregional Connectivity Study (ICS).

Level 2 scenarios include the following:

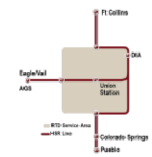
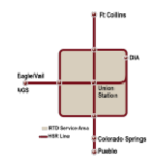
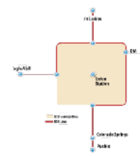
- Concept A1: Direct routing through Denver, with the east-west corridor either using I-76 (A1a) or US-6 (A1b).
- Concept A5: Eastern Beltway, with the east-west corridor either using I-76 (A5a) or US-6 (A5b).
- Concept A6: Complete Beltway, with the east-west corridor either using I-76 (A6a) or US-6 (A6b).
- Concept B2A: Denver Periphery – Southwest (excludes northwest beltway).
- Concept C1: Shared Track with RTD.

Two concepts were later added for evaluation:

- Concept B5: Denver Periphery – Northwest (excludes southwest beltway).
- AGS Stand-Alone: Tests the I-70 corridor only, west of E-470.

While these scenarios are more fully described in other reports, for reference Table 1 provides a simple schematic of each concept.

Table 1. Level 2 Concepts

Concept		Schematic
A1a	**Direct Routing through Denver** *E-W via I-76 with station at I-76/72nd*	
A1b	**Direct Routing through Denver** *E-W via US-6 with station at DUS*	
A5a	**Eastern Beltway** *E-W via I-76 with station at I-76/72nd*	
A5b	**Eastern Beltway** *E-W via US-6 with station at DUS*	
A6a	**Complete Beltway** *E-W via I-76 with station at I-76/72nd*	
A6b	**Complete Beltway** *E-W via US-6 with station at DUS*	
B2A	**Denver Periphery - Southwest** *Excludes Northwest Beltway*	
C1	**Shared Track with RTD**	
B5	**Denver Periphery - Northwest** *Excludes Southwest Beltway*	
AGS	**Stand-Alone**	

2.0 O&M Cost Methodology for Level 2 Screening

The Level 2 screening evaluates scenarios that survived the Level 1 fatal flaw analysis and begins to quantify differences between alternatives. This level of screening still involves a large number of alternatives and calls for a straightforward method of quantifying O&M costs for comparison purposes.

Toward this end, the resulting unit costs per train mile from the operating cost analysis provided in the Rocky Mountain Rail Authority *High-Speed Rail Feasibility Study Business Plan*, March 2010 (RMRA study) are applied to alternatives in Level 2 screening. The RMRA study developed costs for six technology types: 79 mph rail, 110 mph rail, 125 mph Maglev, 150 mph rail, 220 mph rail, and 300 mph Maglev.

The RMRA study used a cost build-up method, adapting the costing framework developed for the Midwest Regional Rail System. Nine specific cost areas were identified. These cost areas are summarized in Table 2.

Table 2. Operating Cost Categories and Primary Cost Drivers from RMRA High-Speed Rail Feasibility Study

Cost Category	Cost Driver	Technology Distinction
Equipment Maintenance	Train Miles	Yes
Energy and Fuel	Train Miles	Yes
Train and Engine Crews	Train Miles	Yes
Onboard Service Crews	Train Miles	No
Insurance	Passenger Miles	No
Sales and Marketing	Fixed Cost, Ridership and Revenue	No
Service Administration	Fixed Cost, Train Miles	No
Track and ROW Maintenance	Track Miles	Yes
Station Costs	Number of Stations	No

Source: RMRA *High-Speed Rail Feasibility Study Business Plan*, March 2010.

As noted in Table 2, the RMRA O&M cost method includes distinctions based on technology differences for the following cost areas:

- Train Equipment Maintenance
- Train and Engine Crew
- Energy and Fuel
- On-Board Services
- Insurance Costs
- Track and Right-of-Way Costs
- Station Operations
- System Overhead

For some cost areas, there is minimal or no difference in cost structure. For example, the RMRA study assigns the same unit costs for station operations (cost per station) and insurance costs (cost per passenger mile) regardless of technology. There are, however, substantive unit cost differences for Train Equipment Maintenance, Train and Engine Crew and Fuel and Energy. The unit cost for Train and Engine Crew is influenced by train speed. Technologies with higher operating speeds will have less cost for Train and Engine Crew because those technologies can operate the same service plan in less time. The RMRA report notes that Train Equipment Maintenance is considerably less for Maglev. The RMRA unit cost used for 300 mph Maglev for Train Equipment Maintenance is 45% lower than for 220 mph Electric. The difference is 17% when comparing 125 mph Maglev to 150 mph Electric. The unit cost used for Fuel and Energy in the RMRA study varies depending on grade. The RMRA study's unit cost for 300 mph Maglev is 8% to 24% less than 220 mph Electric, depending on the grade. The 125 mph Maglev technology, however, has a higher unit cost than the 150 mph Electric option for Fuel and Energy. Both Electric and Maglev technologies have substantial lower Fuel and Energy unit costs than diesel technology options.

It is important to keep in mind that these cost differences by technology only apply to portions of the overall cost estimate. As an example, it was noted above that Maglev is 45% less expensive than 220 mph Electric Train Equipment Maintenance. However, this particular cost center is just 26% of the overall cost for 220 mph Electric. Thus, the 45% savings associated with Maglev only applies to this particular cost center.

Associated statistics were developed for each technology option in the RMRA, and applied to the O&M cost model. This led to the calculation of total annual operating costs in 2008 dollars for each system option. The total costs were then divided by the total train miles, in order to express an average cost per train mile. Table 3 provides the resulting average cost per train mile as calculated in the RMRA study in 2008 dollars.

Table 3. Average Cost per Train Mile by Technology

Technology	2008 (RMRA)	2013
escalation factor		1.0907
79 mph Rail	$52.16	$56.89
110 mph Rail	$50.07	$54.61
125 mph Maglev	$45.46	$49.58
150 mph Rail	$49.32	$53.79
220 mph Rail	$50.18	$54.73
300 mph Maglev	$38.11	$41.56

Source: RMRA *High-Speed Rail Feasibility Study Business Plan*, March 2010 ($2008); Connetics Transportation Group (escalation to $2013).

Table 3 also provides these unit costs as escalated to 2013 dollars. Based on the Bureau of Labor Statistics' Consumer Price Index – Urban Consumers (CPI-U) for the Denver-Boulder-Greeley region, an escalation factor of 1.07 was determined by comparing the annual CPI-U from 2008 to 2012. Further escalation to 2013 dollars was achieved by assuming the same annual growth rate as 2011 to 2012, leading to an escalation factor of 1.09 applied to 2008 costs.

Rail operating plans were developed in order to estimate the annual train miles for each of the Level 2 scenarios. These operating plans are provided in a separate report, *Level 2 Service Plans,* April 2013 (revised May 15, 2013). For all scenarios except A6, a basic frequency service plan was developed as well as a more aggressive capacity-based service plan. The basic frequency service plan generally allowed for 24 daily round trips per corridor, whereas the capacity-based service plan was based on 36 daily round trips per corridor. The service plan for A6 had appreciably more service: use of the complete Beltway allowed additional service directly linking markets outside of Denver, while maintaining service patterns penetrating Denver.

Table 4 provides a summary of the resulting annual revenue train miles and annual revenue train hours for each of the scenarios.

Table 4. Summary of Annual Revenue Train Miles and Annual Revenue Train Hours by Scenario

Concept		Service Plan	Annual Revenue Train-Miles	Annual Revenue Train-Hours
A1a	Direct Routing through Denver, E-W via I-76	Basic	5,086,300	71,770
A1a	Direct Routing through Denver, E-W via I-76	Capacity-Based	6,862,500	97,040
A1b	Direct Routing through Denver, E-W via US-6	Basic	5,095,700	71,770
A1b	Direct Routing through Denver, E-W via US-6	Capacity-Based	6,876,100	97,040
A5a	Eastern Beltway, E-W via I-76	Basic	5,146,500	71,770
A5a	Eastern Beltway, E-W via I-76	Capacity-Based	6,948,100	97,040
A5b	Eastern Beltway, E-W via US-6	Basic	5,155,900	71,770
A5b	Eastern Beltway, E-W via US-6	Capacity-Based	6,961,700	97,040
A6a	Complete Beltway, E-W via I-76	Balanced	10,738,600	147,805
A6b	Complete Beltway, E-W via US-6	Balanced	10,748,000	147,805
B2A	Denver Periphery Southwest	Basic	5,540,800	74,780
B2A	Denver Periphery Southwest	Capacity-Based	7,521,250	103,060
C1	Shared Track with RTD	Basic	5,208,280	83,546
C1	Shared Track with RTD	Capacity-Based	7,024,380	112,220
B5	Denver Periphery Northwest	Basic	5,557,800	74,780
AGS	Stand-Alone	Basic	1,486,600	22,380

3.0 Level 2 O&M Cost Estimates

To determine the O&M costs for Level 2 screening, the annual train-miles for each scenario are multiplied by the RMRA-calculated average cost per train mile in 2013 dollars.

O&M statistics and associated O&M cost estimates were separated between the Front Range corridor and Mountain corridor, with the Mountain corridor defined in two different ways: (1) the Mountain corridor totals include all direct lines to/from Eagle County and Breckenridge, and (2) the Mountain corridor totals only include train miles west of the JeffCo (West Suburban) Station.

Table 5 presents the annual revenue train miles and associated O&M costs separated between the Front Range corridor and the full length of the Mountain corridor lines.

Table 5. Summary of Annual Revenue Train Miles and Estimated Annual O&M Cost (Mountain Corridor Assigned Full Service Patterns)

Corridor	Concept		79 mph Rail	110 mph Rail	125 mph Maglev	150 mph Rail	220 mph Rail	300 mph Maglev
			$56.89	$54.61	$49.58	$53.79	$54.73	$41.56
Front Range Corridor	A1a	Basic	$172,878,000	$165,951,000	$150,672,000	$163,465,000	$166,316,000	$126,311,000
	A1a	Capacity-Based	$237,902,000	$228,369,000	$207,343,000	$224,948,000	$228,871,000	$173,820,000
	A1b	Basic	$172,878,000	$165,951,000	$150,672,000	$163,465,000	$166,316,000	$126,311,000
	A1b	Capacity-Based	$237,902,000	$228,369,000	$207,343,000	$224,948,000	$228,871,000	$173,820,000
	A5a	Basic	$176,303,000	$169,239,000	$153,657,000	$166,704,000	$169,610,000	$128,813,000
	A5a	Capacity-Based	$242,771,000	$233,044,000	$211,587,000	$229,553,000	$233,556,000	$177,378,000
	A5b	Basic	$176,303,000	$169,239,000	$153,657,000	$166,704,000	$169,610,000	$128,813,000
	A5b	Capacity-Based	$242,771,000	$233,044,000	$211,587,000	$229,553,000	$233,556,000	$177,378,000
	A6a	Balanced	$269,031,000	$258,251,000	$234,474,000	$254,383,000	$258,819,000	$196,564,000
	A6b	Balanced	$269,031,000	$258,251,000	$234,474,000	$254,383,000	$258,819,000	$196,564,000
	B2A	Basic	$143,069,000	$137,336,000	$124,691,000	$135,279,000	$137,638,000	$104,531,000
	B2A	Capacity-Based	$176,300,000	$169,236,000	$153,654,000	$166,701,000	$169,608,000	$128,811,000
	C1	Basic	$174,413,000	$167,424,000	$152,010,000	$164,917,000	$167,792,000	$127,433,000
	C1	Capacity-Based	$240,159,000	$230,536,000	$209,310,000	$227,083,000	$231,043,000	$175,469,000
	B5	Basic	$143,069,000	$137,336,000	$124,691,000	$135,279,000	$137,638,000	$104,531,000
	AGS	Basic	NA	NA	NA	NA	NA	NA
Mountain Corridor	A1a	Basic	$116,473,000	$111,806,000	$101,512,000	$110,132,000	$112,052,000	$85,100,000
	A1a	Capacity-Based	$152,495,000	$146,385,000	$132,907,000	$144,192,000	$146,706,000	$111,418,000
	A1b	Basic	$117,008,000	$112,320,000	$101,978,000	$110,637,000	$112,566,000	$85,490,000
	A1b	Capacity-Based	$153,269,000	$147,127,000	$133,581,000	$144,924,000	$147,451,000	$111,984,000
	A5a	Basic	$116,473,000	$111,806,000	$101,512,000	$110,132,000	$112,052,000	$85,100,000
	A5a	Capacity-Based	$152,495,000	$146,385,000	$132,907,000	$144,192,000	$146,706,000	$111,418,000
	A5b	Basic	$117,008,000	$112,320,000	$101,978,000	$110,637,000	$112,566,000	$85,490,000
	A5b	Capacity-Based	$153,269,000	$147,127,000	$133,581,000	$144,924,000	$147,451,000	$111,984,000
	A6a	Balanced	$341,871,000	$328,173,000	$297,957,000	$323,257,000	$328,893,000	$249,783,000
	A6b	Balanced	$342,406,000	$328,686,000	$298,423,000	$323,762,000	$329,408,000	$250,174,000
	B2A	Basic	$172,139,000	$165,241,000	$150,027,000	$162,766,000	$165,604,000	$125,771,000
	B2A	Capacity-Based	$251,572,000	$241,492,000	$219,257,000	$237,874,000	$242,022,000	$183,808,000
	C1	Basic	$121,878,000	$116,994,000	$106,222,000	$115,242,000	$117,251,000	$89,048,000
	C1	Capacity-Based	$159,447,000	$153,058,000	$138,966,000	$150,765,000	$153,394,000	$116,498,000
	B5	Basic	$173,106,000	$166,170,000	$150,870,000	$163,681,000	$166,535,000	$126,477,000
	AGS	Basic	$84,570,000	$81,182,000	$73,707,000	$79,966,000	$81,360,000	$61,790,000
TOTAL	A1a	Basic	$289,351,000	$277,757,000	$252,184,000	$273,597,000	$278,368,000	$211,411,000
	A1a	Capacity-Based	$390,397,000	$374,754,000	$340,250,000	$369,140,000	$375,577,000	$285,238,000
	A1b	Basic	$289,886,000	$278,271,000	$252,650,000	$274,102,000	$278,882,000	$211,801,000
	A1b	Capacity-Based	$391,171,000	$375,496,000	$340,924,000	$369,872,000	$376,322,000	$285,804,000
	A5a	Basic	$292,776,000	$281,045,000	$255,169,000	$276,836,000	$281,662,000	$213,913,000
	A5a	Capacity-Based	$395,266,000	$379,429,000	$344,494,000	$373,745,000	$380,262,000	$288,796,000
	A5b	Basic	$293,311,000	$281,559,000	$255,635,000	$277,341,000	$282,176,000	$214,303,000
	A5b	Capacity-Based	$396,040,000	$380,171,000	$345,168,000	$374,477,000	$381,007,000	$289,362,000
	A6a	Balanced	$610,902,000	$586,424,000	$532,431,000	$577,640,000	$587,712,000	$446,347,000
	A6b	Balanced	$611,437,000	$586,937,000	$532,897,000	$578,145,000	$588,227,000	$446,738,000
	B2A	Basic	$315,208,000	$302,577,000	$274,718,000	$298,045,000	$303,242,000	$230,302,000
	B2A	Capacity-Based	$427,872,000	$410,728,000	$372,911,000	$404,575,000	$411,630,000	$312,619,000
	C1	Basic	$296,291,000	$284,418,000	$258,232,000	$280,159,000	$285,043,000	$216,481,000
	C1	Capacity-Based	$399,606,000	$383,594,000	$348,276,000	$377,848,000	$384,437,000	$291,967,000
	B5	Basic	$316,174,000	$303,506,000	$275,562,000	$298,959,000	$304,172,000	$231,009,000
	AGS	Basic	$84,570,000	$81,182,000	$73,707,000	$79,966,000	$81,360,000	$61,790,000

Table 6 presents the annual revenue train miles and associated O&M costs, separating out the portion of the Mountain corridor west of the JeffCo (West Suburban) Station.

Table 6. Summary of Annual Revenue Train Miles and Estimated Annual O&M Cost (Mountain Corridor Assigned Segment West of JeffCo/West Suburban Station)

Corridor	Concept		79 mph Rail	110 mph Rail	125 mph Maglev	150 mph Rail	220 mph Rail	300 mph Maglev
			$56.89	$54.61	$49.58	$53.79	$54.73	$41.56
Front Range Corridor	A1a	Basic	$204,764,000	$196,559,000	$178,462,000	$193,615,000	$196,991,000	$149,608,000
	A1a	Capacity-Based	$280,010,000	$268,791,000	$244,043,000	$264,765,000	$269,381,000	$204,586,000
	A1b	Basic	$205,379,000	$197,149,000	$178,997,000	$194,196,000	$197,582,000	$150,057,000
	A1b	Capacity-Based	$280,852,000	$269,599,000	$244,777,000	$265,561,000	$270,191,000	$205,201,000
	A5a	Basic	$208,189,000	$199,847,000	$181,447,000	$196,853,000	$200,286,000	$152,110,000
	A5a	Capacity-Based	$284,880,000	$273,465,000	$248,287,000	$269,369,000	$274,066,000	$208,144,000
	A5b	Basic	$208,803,000	$200,437,000	$181,982,000	$197,434,000	$200,877,000	$152,559,000
	A5b	Capacity-Based	$285,722,000	$274,273,000	$249,021,000	$270,165,000	$274,876,000	$208,759,000
	A6a	Balanced	$432,050,000	$414,739,000	$376,553,000	$408,526,000	$415,650,000	$315,672,000
	A6b	Balanced	$432,574,000	$415,241,000	$377,009,000	$409,021,000	$416,153,000	$316,054,000
	B2A	Basic	$230,427,000	$221,194,000	$200,828,000	$217,880,000	$221,680,000	$168,358,000
	B2A	Capacity-Based	$311,729,000	$299,238,000	$271,687,000	$294,756,000	$299,895,000	$227,760,000
	C1	Basic	$211,612,000	$203,133,000	$184,431,000	$200,091,000	$203,580,000	$154,612,000
	C1	Capacity-Based	$289,214,000	$277,625,000	$252,064,000	$273,467,000	$278,235,000	$211,310,000
	B5	Basic	$231,411,000	$222,138,000	$201,686,000	$218,811,000	$222,626,000	$169,077,000
	AGS	Basic	NA	NA	NA	NA	NA	NA
Mountain Corridor	A1a	Basic	$84,587,000	$81,198,000	$73,722,000	$79,982,000	$81,376,000	$61,803,000
	A1a	Capacity-Based	$110,386,000	$105,963,000	$96,207,000	$104,376,000	$106,196,000	$80,652,000
	A1b	Basic	$84,508,000	$81,122,000	$73,653,000	$79,906,000	$81,300,000	$61,744,000
	A1b	Capacity-Based	$110,318,000	$105,898,000	$96,148,000	$104,311,000	$106,130,000	$80,602,000
	A5a	Basic	$84,587,000	$81,198,000	$73,722,000	$79,982,000	$81,376,000	$61,803,000
	A5a	Capacity-Based	$110,386,000	$105,963,000	$96,207,000	$104,376,000	$106,196,000	$80,652,000
	A5b	Basic	$84,508,000	$81,122,000	$73,653,000	$79,906,000	$81,300,000	$61,744,000
	A5b	Capacity-Based	$110,318,000	$105,898,000	$96,148,000	$104,311,000	$106,130,000	$80,602,000
	A6a	Balanced	$178,851,000	$171,685,000	$155,878,000	$169,113,000	$172,062,000	$130,675,000
	A6b	Balanced	$178,863,000	$171,696,000	$155,888,000	$169,124,000	$172,073,000	$130,684,000
	B2A	Basic	$84,781,000	$81,384,000	$73,891,000	$80,165,000	$81,563,000	$61,944,000
	B2A	Capacity-Based	$116,143,000	$111,490,000	$101,225,000	$109,820,000	$111,735,000	$84,859,000
	C1	Basic	$84,678,000	$81,285,000	$73,801,000	$80,068,000	$81,464,000	$61,869,000
	C1	Capacity-Based	$110,392,000	$105,969,000	$96,212,000	$104,381,000	$106,201,000	$80,656,000
	B5	Basic	$84,764,000	$81,367,000	$73,876,000	$80,149,000	$81,546,000	$61,931,000
	AGS	Basic	$84,570,000	$81,182,000	$73,707,000	$79,966,000	$81,360,000	$61,790,000
TOTAL	A1a	Basic	$289,351,000	$277,757,000	$252,184,000	$273,597,000	$278,367,000	$211,411,000
	A1a	Capacity-Based	$390,396,000	$374,754,000	$340,250,000	$369,141,000	$375,577,000	$285,238,000
	A1b	Basic	$289,887,000	$278,271,000	$252,650,000	$274,102,000	$278,882,000	$211,801,000
	A1b	Capacity-Based	$391,170,000	$375,497,000	$340,925,000	$369,872,000	$376,321,000	$285,803,000
	A5a	Basic	$292,776,000	$281,045,000	$255,169,000	$276,835,000	$281,662,000	$213,913,000
	A5a	Capacity-Based	$395,266,000	$379,428,000	$344,494,000	$373,745,000	$380,262,000	$288,796,000
	A5b	Basic	$293,311,000	$281,559,000	$255,635,000	$277,340,000	$282,177,000	$214,303,000
	A5b	Capacity-Based	$396,040,000	$380,171,000	$345,169,000	$374,476,000	$381,006,000	$289,361,000
	A6a	Balanced	$610,901,000	$586,424,000	$532,431,000	$577,639,000	$587,712,000	$446,347,000
	A6b	Balanced	$611,437,000	$586,937,000	$532,897,000	$578,145,000	$588,226,000	$446,738,000
	B2A	Basic	$315,208,000	$302,578,000	$274,719,000	$298,045,000	$303,243,000	$230,302,000
	B2A	Capacity-Based	$427,872,000	$410,728,000	$372,912,000	$404,576,000	$411,630,000	$312,619,000
	C1	Basic	$296,290,000	$284,418,000	$258,232,000	$280,159,000	$285,044,000	$216,481,000
	C1	Capacity-Based	$399,606,000	$383,594,000	$348,276,000	$377,848,000	$384,436,000	$291,966,000
	B5	Basic	$316,175,000	$303,505,000	$275,562,000	$298,960,000	$304,172,000	$231,008,000
	AGS	Basic	$84,570,000	$81,182,000	$73,707,000	$79,966,000	$81,360,000	$61,790,000

Because of the wide variation in technologies and service plans, annual O&M cost estimates vary from $211 to $588 million for the 125-300 mph options (rail and maglev). For the basic frequency service plans, this range narrows to $211 to $304 million. (All ranges exclude the AGS stand-alone analysis.) For comparison purposes, the RMRA had annual O&M costs ranging from $360 to $475 million for their 125-300 mph options (rail and maglev), though it is worth noting that the RMRA service plans are not directly comparable.

Table 7 presents the proportion of O&M costs attributed to Front Range service versus Mountain Corridor service as calculated for the full length of the line. For the simplest configurations such as Concepts A1, A5 and C1, the Front Range corridor is responsible for about 60% and the Mountain corridor accounts for 40% of the total annual O&M cost. The other configurations (Concepts A6, B2A, and B5) usually lead to a larger proportion attributable to the Mountain corridor, from 55% to 59% of the total annual O&M cost.

Table 8 presents the proportion of O&M costs attributed to the Front Range service versus Mountain corridor service, where Mountain corridor costs are truncated to isolate the segment west of the JeffCo (West Suburban) Station.

In this case, for most configurations the Mountain corridor is assigned a much smaller share of the total annual O&M costs, from 27 to 29%.

Table 7. Proportion of Total Estimated Annual O&M Cost Assigned by Corridor (Mountain Corridor Assigned Full Service Patterns)

Corridor	Concept		79 mph Rail	110 mph Rail	125 mph Maglev	150 mph Rail	220 mph Rail	300 mph Maglev
			$56.89	$54.61	$49.58	$53.79	$54.73	$41.56
Front Range Corridor	A1a	Basic	60%	60%	60%	60%	60%	60%
	A1a	Capacity-Based	61%	61%	61%	61%	61%	61%
	A1b	Basic	60%	60%	60%	60%	60%	60%
	A1b	Capacity-Based	61%	61%	61%	61%	61%	61%
	A5a	Basic	60%	60%	60%	60%	60%	60%
	A5a	Capacity-Based	61%	61%	61%	61%	61%	61%
	A5b	Basic	60%	60%	60%	60%	60%	60%
	A5b	Capacity-Based	61%	61%	61%	61%	61%	61%
	A6a	Balanced	44%	44%	44%	44%	44%	44%
	A6b	Balanced	44%	44%	44%	44%	44%	44%
	B2A	Basic	45%	45%	45%	45%	45%	45%
	B2A	Capacity-Based	41%	41%	41%	41%	41%	41%
	C1	Basic	59%	59%	59%	59%	59%	59%
	C1	Capacity-Based	60%	60%	60%	60%	60%	60%
	B5	Basic	45%	45%	45%	45%	45%	45%
	AGS	Basic	NA	NA	NA	NA	NA	NA
Mountain Corridor	A1a	Basic	40%	40%	40%	40%	40%	40%
	A1a	Capacity-Based	39%	39%	39%	39%	39%	39%
	A1b	Basic	40%	40%	40%	40%	40%	40%
	A1b	Capacity-Based	39%	39%	39%	39%	39%	39%
	A5a	Basic	40%	40%	40%	40%	40%	40%
	A5a	Capacity-Based	39%	39%	39%	39%	39%	39%
	A5b	Basic	40%	40%	40%	40%	40%	40%
	A5b	Capacity-Based	39%	39%	39%	39%	39%	39%
	A6a	Balanced	56%	56%	56%	56%	56%	56%
	A6b	Balanced	56%	56%	56%	56%	56%	56%
	B2A	Basic	55%	55%	55%	55%	55%	55%
	B2A	Capacity-Based	59%	59%	59%	59%	59%	59%
	C1	Basic	41%	41%	41%	41%	41%	41%
	C1	Capacity-Based	40%	40%	40%	40%	40%	40%
	B5	Basic	55%	55%	55%	55%	55%	55%
	AGS	Basic	100%	100%	100%	100%	100%	100%
TOTAL	A1a	Basic	100%	100%	100%	100%	100%	100%
	A1a	Capacity-Based	100%	100%	100%	100%	100%	100%
	A1b	Basic	100%	100%	100%	100%	100%	100%
	A1b	Capacity-Based	100%	100%	100%	100%	100%	100%
	A5a	Basic	100%	100%	100%	100%	100%	100%
	A5a	Capacity-Based	100%	100%	100%	100%	100%	100%
	A5b	Basic	100%	100%	100%	100%	100%	100%
	A5b	Capacity-Based	100%	100%	100%	100%	100%	100%
	A6a	Balanced	100%	100%	100%	100%	100%	100%
	A6b	Balanced	100%	100%	100%	100%	100%	100%
	B2A	Basic	100%	100%	100%	100%	100%	100%
	B2A	Capacity-Based	100%	100%	100%	100%	100%	100%
	C1	Basic	100%	100%	100%	100%	100%	100%
	C1	Capacity-Based	100%	100%	100%	100%	100%	100%
	B5	Basic	100%	100%	100%	100%	100%	100%
	AGS	Basic	100%	100%	100%	100%	100%	100%

Table 8. Proportion of Estimated Annual O&M Cost Assigned by Corridor (Mountain Corridor Assigned Segment West of JeffCo/West Suburban Station)

Corridor	Concept		79 mph Rail	110 mph Rail	125 mph Maglev	150 mph Rail	220 mph Rail	300 mph Maglev
			$56.89	$54.61	$49.58	$53.79	$54.73	$41.56
Front Range Corridor	A1a	Basic	71%	71%	71%	71%	71%	71%
	A1a	Capacity-Based	72%	72%	72%	72%	72%	72%
	A1b	Basic	71%	71%	71%	71%	71%	71%
	A1b	Capacity-Based	72%	72%	72%	72%	72%	72%
	A5a	Basic	71%	71%	71%	71%	71%	71%
	A5a	Capacity-Based	72%	72%	72%	72%	72%	72%
	A5b	Basic	71%	71%	71%	71%	71%	71%
	A5b	Capacity-Based	72%	72%	72%	72%	72%	72%
	A6a	Balanced	71%	71%	71%	71%	71%	71%
	A6b	Balanced	71%	71%	71%	71%	71%	71%
	B2A	Basic	73%	73%	73%	73%	73%	73%
	B2A	Capacity-Based	73%	73%	73%	73%	73%	73%
	C1	Basic	71%	71%	71%	71%	71%	71%
	C1	Capacity-Based	72%	72%	72%	72%	72%	72%
	B5	Basic	73%	73%	73%	73%	73%	73%
	AGS	Basic	NA	NA	NA	NA	NA	NA
Mountain Corridor	A1a	Basic	29%	29%	29%	29%	29%	29%
	A1a	Capacity-Based	28%	28%	28%	28%	28%	28%
	A1b	Basic	29%	29%	29%	29%	29%	29%
	A1b	Capacity-Based	28%	28%	28%	28%	28%	28%
	A5a	Basic	29%	29%	29%	29%	29%	29%
	A5a	Capacity-Based	28%	28%	28%	28%	28%	28%
	A5b	Basic	29%	29%	29%	29%	29%	29%
	A5b	Capacity-Based	28%	28%	28%	28%	28%	28%
	A6a	Balanced	29%	29%	29%	29%	29%	29%
	A6b	Balanced	29%	29%	29%	29%	29%	29%
	B2A	Basic	27%	27%	27%	27%	27%	27%
	B2A	Capacity-Based	27%	27%	27%	27%	27%	27%
	C1	Basic	29%	29%	29%	29%	29%	29%
	C1	Capacity-Based	28%	28%	28%	28%	28%	28%
	B5	Basic	27%	27%	27%	27%	27%	27%
	AGS	Basic	100%	100%	100%	100%	100%	100%
TOTAL	A1a	Basic	100%	100%	100%	100%	100%	100%
	A1a	Capacity-Based	100%	100%	100%	100%	100%	100%
	A1b	Basic	100%	100%	100%	100%	100%	100%
	A1b	Capacity-Based	100%	100%	100%	100%	100%	100%
	A5a	Basic	100%	100%	100%	100%	100%	100%
	A5a	Capacity-Based	100%	100%	100%	100%	100%	100%
	A5b	Basic	100%	100%	100%	100%	100%	100%
	A5b	Capacity-Based	100%	100%	100%	100%	100%	100%
	A6a	Balanced	100%	100%	100%	100%	100%	100%
	A6b	Balanced	100%	100%	100%	100%	100%	100%
	B2A	Basic	100%	100%	100%	100%	100%	100%
	B2A	Capacity-Based	100%	100%	100%	100%	100%	100%
	C1	Basic	100%	100%	100%	100%	100%	100%
	C1	Capacity-Based	100%	100%	100%	100%	100%	100%
	B5	Basic	100%	100%	100%	100%	100%	100%
	AGS	Basic	100%	100%	100%	100%	100%	100%

4.0 Future Refinement of O&M Cost Estimates for Level 3

For the final level of screening, a more detailed analysis is proposed for calculating O&M costs. A rail O&M cost model will be developed, primarily based on the RMRA study. Other sources will be used to confirm and update the assignment of driving variables to specific costs, and the determination of unit costs in the model as appropriate.

Rail operating plans will be developed with greater specificity to refine operating statistics. These statistics will supply the quantities for the resource variables identified in the O&M cost model.

In addition, O&M costs associated with bus service complementing the HSIPR system will be quantified. Bus service plans will be developed to define a local transit feeder distribution network. Bus operating plans will be developed in sufficient detail to quantify the incremental annual service hours. Incremental annual service hours will be multiplied by bus operating expense per revenue vehicle hour, based on similarity of operations to the transit providers in the study area:

- Denver RTD,
- Transfort,
- Loveland Transit (COLT),
- Greeley Transit Services (GET),
- Mountain Metropolitan Transit (MMT), and
- Pueblo Transit System (PT).

Appendix D:

ICS Demand Forecasting Model Documentation

Appendix D:
ICS Demand Forecasting Model Documentation

steer davies gleave

Contents

Tables

Figures

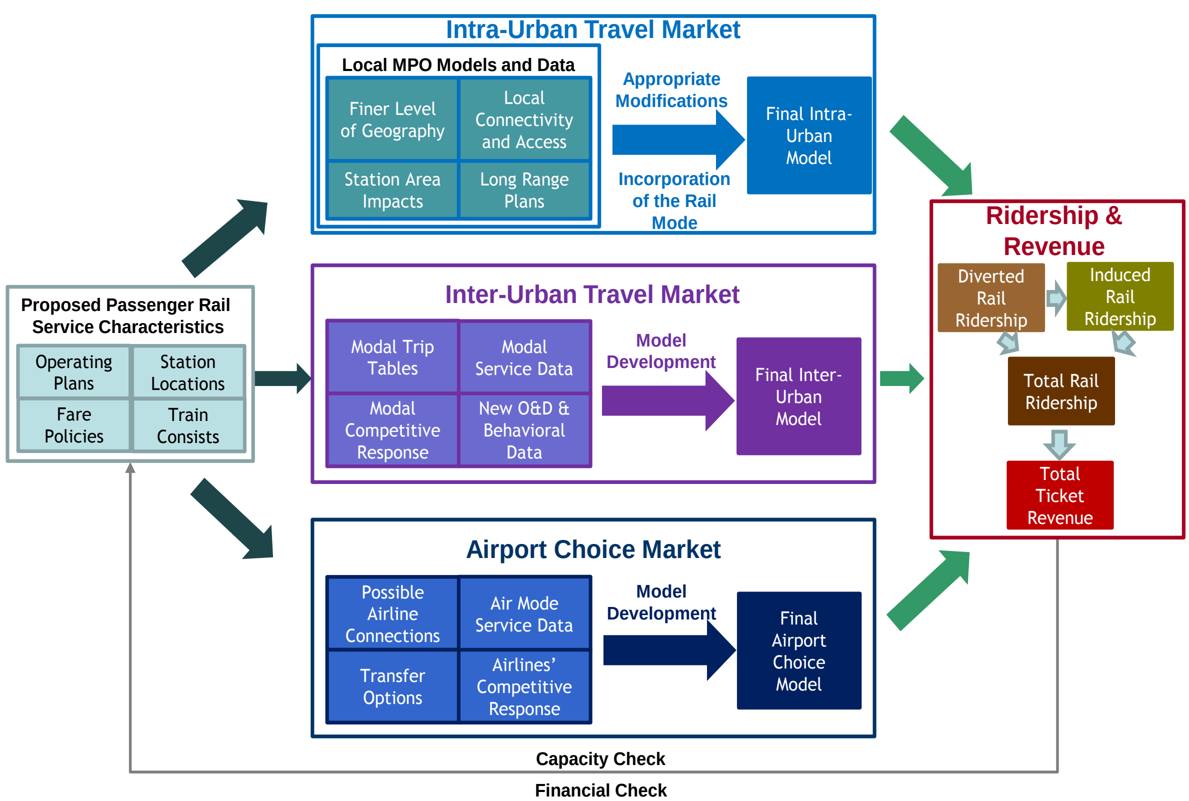
Section 1: Overview of the Ridership and Revenue Forecasting Framework

Steer Davies Gleave applied a well-established travel demand forecasting methodology to analyze ridership and revenue for the Inter-regional Connectivity Study (ICS) Level 2 alternatives. This methodology is quite detailed and is well suited to Level 2 screening purposes. Figure 1 graphically illustrates the forecasting approach. As can be seen, it addresses four distinct travel markets (discussed below) in the ICS study area:

- Inter-urban travel market;
- Denver area intra-urban travel market including the airport access market;
- Airport choice market; and
- Induced demand market.

The demand forecasting steps for each of these travel markets are briefly described below with more details provided in the sections that follow.

FIGURE 1. GENERAL RIDERSHIP AND REVENUE FORECASTING FRAMEWORK



To forecast demand for a rail service alternative (combination of technology and speed, alignment and stopping pattern), the model requires information on the alternative's service characteristics. These include:

- Operating characteristics: stopping patterns, running and dwell times, schedule or frequency;
- Station-to-station fares; and
- Station locations and connectivity/accessibility/parking.

Inter-Urban Travel

The process that the demand model applies to forecast the inter-urban ridership and revenue of a proposed rail service entails five broad steps:

1. *Establish the study area geographic scope and its zone structure:* The inter-urban model covers a geographic area that generally follows the ICS corridors and extends approximately 50 miles on each side of the proposed alignments. The study area is split into 3142 zones. In Metropolitan Planning Organization (MPO) areas, the zones are based on the MPO model traffic analysis zones (TAZs) or some aggregation of them; in other areas they are based on zones used in the I-70 PEIS.
2. *Develop input data including service characteristics for each mode and zone pair:* Modeling input data includes the study area network, historic and future socio-economic variables (population, employment, income, general economic conditions, information on visitors, commuters etc.), information about the service characteristics of existing and future travel modes.
3. *Estimate the current in-scope travel market:* The inter-urban travel market includes trips by air, bus and private automobile, and for different travel purposes. As part of the forecasting model development, data on the patterns and levels of trip making in these markets is prepared on a detailed zone-to-zone basis. While inter-urban air volume data is available from well-established sources, and inter-urban bus volumes can be adequately estimated from published schedules, the lack of detailed up-to-date information on inter-urban automobile travel in the study corridor is a serious data gap. This prompts the study to undertake a program of original travel data collection, using anonymous cell phone data to understand the origins and destinations of auto travelers in the study corridors.
4. *Estimate how this market will grow in the future:* This step involves the development of econometric travel growth models for the auto and bus modes, reflecting trends in socio-economic variables such as population and employment. Future year air trip tables are prepared based on published FAA Terminal Area forecasts of total annual airport enplanements for each of the study area airports.
5. *Estimate the potential market share that the new rail service will capture (i.e. the ridership):* A standard model form (called a nested logit model) is used to predict the market share of each inter-urban mode based on the respective service characteristics of the modes in competition between each zone pair. Service characteristics include time, cost, frequency, reliability, and quality of service, with time and cost broken down into their access, egress, transfer, terminal and line haul components. Mode-specific constants account for the effects of other (not explicitly modeled) characteristics of rail relative to other modes. These shares are then applied to the total zone-to-zone travel volume to predict the volume of travel by each mode, including the new rail mode. This process is carried out separately for the different trip purposes, and the results aggregated.

The nested logit model incorporates information about how travelers assess and trade off different modal service characteristics. This information is obtained from Stated Preference (SP) surveys of study area residents that were conducted as part of the forecasting effort; this type of survey is routinely used to elicit traveler preferences and tradeoffs involving different modal attributes.

Intra-Urban Travel

As all the Level 2 alternatives include multiple stations in the Denver metropolitan area, they will provide intra-urban as well as inter-urban service. The travel forecasting activity considers interactions between the rail project and the Denver metropolitan transportation system both as regards the metropolitan access/egress portion of inter-urban ICS rail trips, as well as the functioning of the ICS project as a local travel mode within the Denver area. The forecasting activity uses DRCOG's Compass model to forecast Denver-area ICS project travel demands, treating the rail project as an additional travel mode within the already-defined mix of available urban modes and with adjustments as required. This approach makes maximum use of the detailed understanding of Denver-area travel patterns and behavior already embodied in the Compass model system.[1]

Airport Choice

Denver International Airport (DEN) is an important national hub due to the large number of destinations served, and the presence of major carriers there. Locally, it provides connection options for air trips that begin or end at the study area regional airports, Colorado Springs (COS) and Eagle County Regional (EGE). Because all of the Level 2 alternatives include a rail station at DEN, air travelers who begin or end their trip at COS or EGE and change planes at DEN will also have the option to access DEN by rail. The ICS travel demand forecasting effort develops an airport choice model to forecast these potential shifts by connecting air travelers.

Induced Demand

Induced travel refers to trips that were not made before a project opens, but which come to be made as a result of the mobility and accessibility improvement that the project brings about. Induced travel resulting from the introduction of the Level 2 rail alternatives is forecast using a simple elasticity-based approach, where the elasticity is expressed as the percentage impact on travel volumes resulting from a percent change in accessibility. Accessibility, in turn, is defined in terms of a generalized cost or logsum variable computed from the nested logit model developed for this study from the collected SP survey data.

[1] Intra-urban travel impacts of the AGS/Train for the ICS study are likely to be less significant in the Colorado Springs, Fort Collins and Pueblo urban areas. These areas will be adequately handled by the inter-urban travel modeling approach described earlier.

Section 2: Ridership and Revenue Modeling for the Inter-Urban Travel Market

This section will describe in detail the travel demand forecasting process, the input data and the travel demand models used to produce ridership and revenue forecasts for the inter-urban travel market.

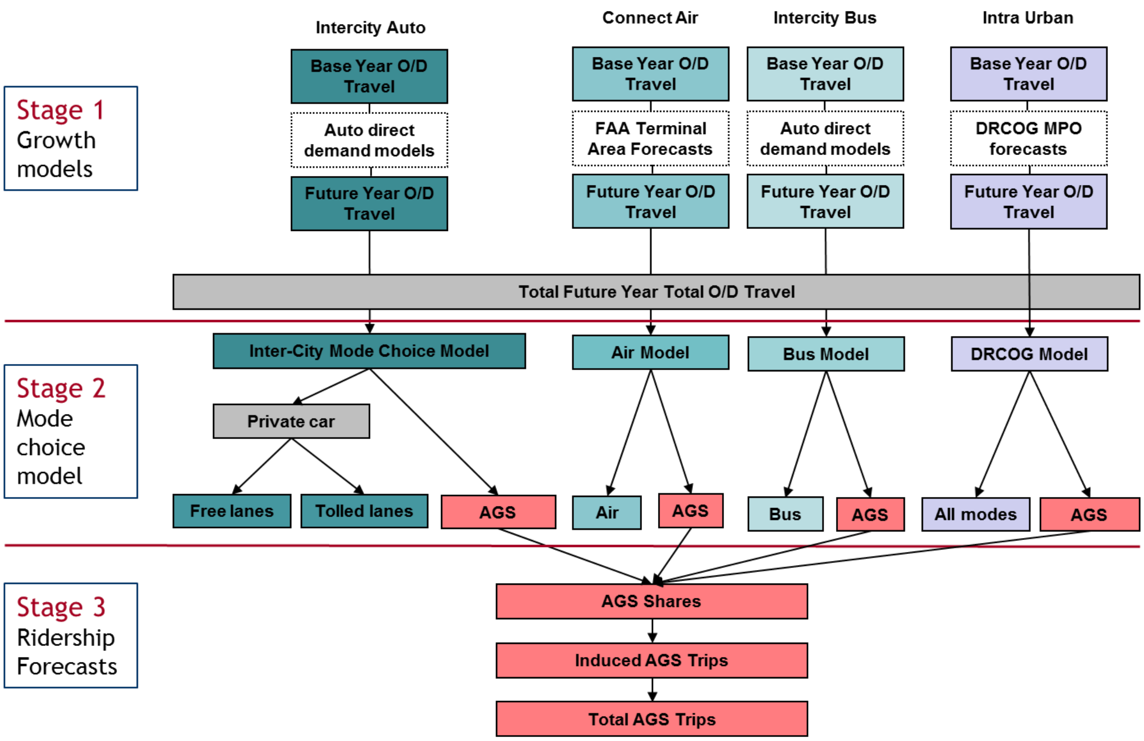
Demand Forecasting Process

The travel demand model implements a well-established three-stage process for forecasting inter-urban AGS/Train ridership and revenue for 2035, the analysis horizon year chosen for this study (Figure 2). In the first step, the growth of the travel markets to 2035 is estimated. In the second step, the mode shares for all of the inter-urban travel modes including the AGS/Train are calculated using mode choice models developed as part of this study. In the final step, the induced ridership is estimated, and this is added to the forecast of diverted AGS/Train trips to produce the total ridership forecast.

Stage 1 estimates the 2035 origin-destination (OD) travel volume of all relevant inter-urban modes by growing base year OD volumes to 2035. The base year auto inter-urban trip table[2] is grown to 2035 using growth rates obtained from direct demand models estimated for this study (described later in this section). A direct demand model calculates the volume of OD travel by a particular mode as a function of socio-economic (e.g. population, income, employment) and LOS (e.g. time, cost etc.) data for the OD pair. The various mode-specific trip tables developed in this way produce the total travel volumes for 2035.

[2] Obtained from anonymous cell phone movement data in the study area and described in detail later in Section 3.

FIGURE 2. THE RIDERSHIP AND REVENUE FORECASTING PROCESS



Stage 2 applies mode choice models (described in detail later in this section) to predict the share of each considered mode in the future year, considering their respective Level of Service (LOS) characteristics. Market-specific mode choice models are applied to predict, for 2035 and for each OD pair, the share of travelers who will use the AGS/Train mode; separate models are applied for different travel purposes. The auto inter-urban mode choice models have a nested logit form and compute, for each available mode, the probability that an OD traveler making a particular trip type will choose the mode given the characteristics of the traveler, the trip and the competing modes' LOS in 2035. The nested logit model structure is shown in Figure 2. These mode choice models aree developed, whenever possible, from statistical analysis of Stated Preference (SP) survey[3] data in which travelers express their choices in hypothetical situations presented to them as well as information pertaining to their travel characteristics in actual travel situations for reference trips. These sources are supplemented by results from other high-speed and inter-urban passenger rail studies in the US and elsewhere, and by engineering judgment.

Stage 3 calculates actual volumes on each inter-urban mode by relating the mode shares to the total travel volume; it also estimates the volume of new trips that result from travel condition improvements (induced travel). The AGS/Train mode shares computed in Stage 2 are applied to the modal trips estimated in Stage 1 to obtain the corresponding AGS/Train modes' ridership; this computation is carried out for each OD pair and separately for each market. Induced travel

[3] A SP survey was undertaken specifically as part of this study; its details are described in Section 3.

volumes are also calculated in this stage; elasticity-based induced demand models, which relate a percentage change in demand to a corresponding percentage change in generalized cost, are developed and applied for this purpose. The generalized costs used in the induced demand models are calculated from the mode choice models used in Stage 2. For each OD pair and travel purpose, the combined results of the mode choice and induced travel models for 2035 provide the AGS/Train demand forecasts for that year. These OD level ridership forecasts are then multiplied by the corresponding fares (for each OD pair, and separately by travel purposes) to calculate the ticket revenue. Forecasts for individual OD pairs and purposes are then aggregated to the AGS/Train system as a whole.

Input Data

This section describes the input data used to produce the AGS/Train ridership and revenue estimates for forecast year 2035. It discusses the development of the geographic zone system, socioeconomic variables, OD trip tables, and LOS characteristics for each mode considered.

Study Area

THE INTER-URBAN MODEL STUDY AREA IS SHOWN IN

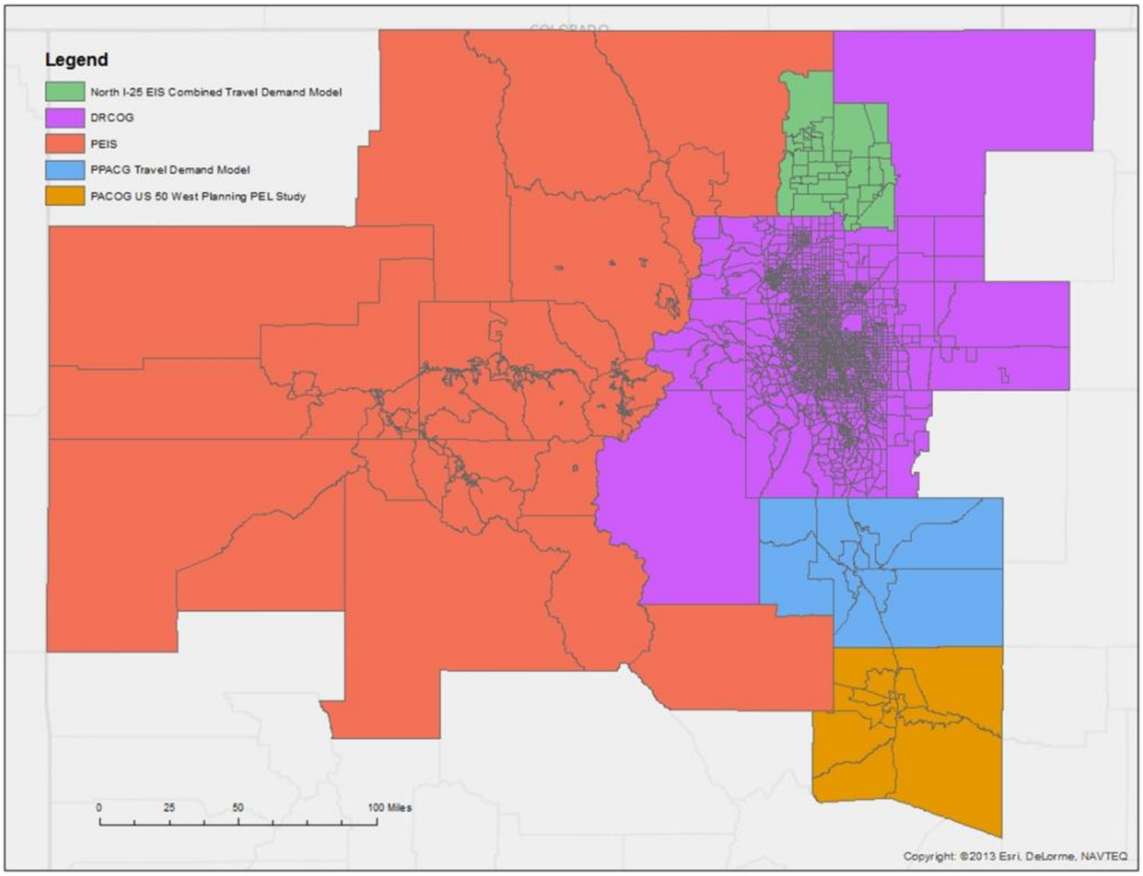
Figure 3. The study area extends approximately 50 miles from the proposed AGS/Train corridors and is divided into geographic units called zones. Zones are important to the modeling process because they represent the smallest level of geography defined as trip origins and destinations.

The zone system is developed in part by combining the zones used in the travel demand models of the study area Metropolitan Planning Organizations (MPOs) – Denver Regional Council of Governments (DRCOG), North Front Range MPO (NFRMPO), Pikes Peak Area Council of Governments (PPACG), Pueblo Area Council of Governments (PACOG). For the portion of the study area that is not covered by an MPO model – namely the I-70 mountain corridor area – zonal boundaries used in existing PEIS study are used. For the Denver metropolitan area DRCOG's original zone system of the COMPASS model is maintained. Zones in other MPO models outside of the Denver metro area are further aggregated. After these adjustments, the number of zones in the study area totals 3142. The breakdown of zones by original travel demand model is detailed in Table 1.

TABLE 1. NUMBER OF ZONES BY TRAVEL DEMAND MODEL

Model	Number of Zones
NFRMPO	40
DRCOG	2807
PPACG	14
PACOG	14
PEIS	267
Total	**3142**

FIGURE 3. ZONE SYSTEM STUDY AREA



Socioeconomics

Socioeconomic variables, including population, employment, and mean household income, are fundamental to forecasting ridership and revenue. Socioeconomic variables serve as inputs into the inter-urban auto direct demand model, which determines the growth factors used to grow the inter-urban auto trip tables from 2011 to 2035. As a result, 2035 trip tables are sensitive to zone-level changes in population, employment and income.

The MPO travel demand models used to develop the zone system contain corresponding socioeconomic data at the zone level. Because each model employs a unique methodology for estimating socioeconomic variables and contains different base and forecast years, other sources are also used where necessary to establish consistency across the entire study area. These other sources are shown in Table 2.

TABLE 2. SOCIOECONOMIC DATA SOURCES

Data	Source
Population	2010 Census
Employment	Woods & Poole
Mean Household Income	Woods & Poole

Census 2010 data is used for base year population and was aggregated from the block group to the zone level. In order to get population for 2035, growth rates calculated from MPO model socioeconomic data are applied to the Census 2010 population. For 2010 and 2035 employment and mean household income, data from Woods & Poole, a commercial company that develops socioeconomic projections through 2040, is used. Employment and income data is allocated to the zone level based on MPO travel demand model employment and income distributions. Table 3 shows the total population, total employment, mean household income, and growth rates assumed for the study area.

TABLE 3. SOCIOECONOMIC STUDY AREA TOTALS AND GROWTH RATES

	2010 Total	2035 Total	CAGR 2010-2035
Population	4,655,751	6,739,232	1.55%
Employment	2,880,906	4,086,180	1.47%
Mean HH Income	$103,140	$335,135	4.83%

Figure 4, Figure 5, and Figure 6 illustrate county-level population density, employment density, and mean household income by county in the study area. These figures show highest population density, employment density, and income in the Denver metropolitan area. The maps also show that the areas of high population density generally also experience high employment density. It is interesting to note that the highest growth rate in the variables considered (especially population) occurs outside of the metropolitan areas. Consequently, this trend leads to higher growth rates for trips originating or ending in suburban/rural zones from 2011-2035.

FIGURE 4. 2035 POPULATION DENSITY AND GROWTH BY COUNTY

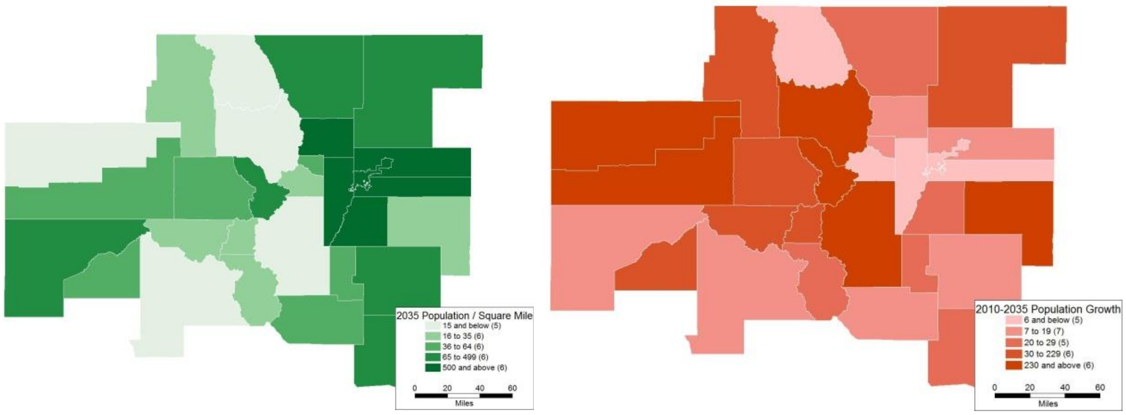


FIGURE 5. 2035 EMPLOYMENT DENSITY AND GROWTH BY COUNTY

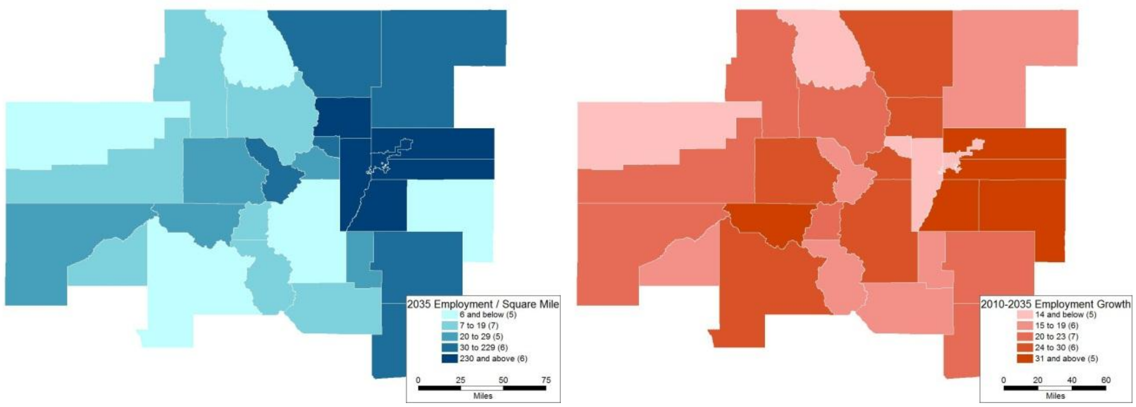
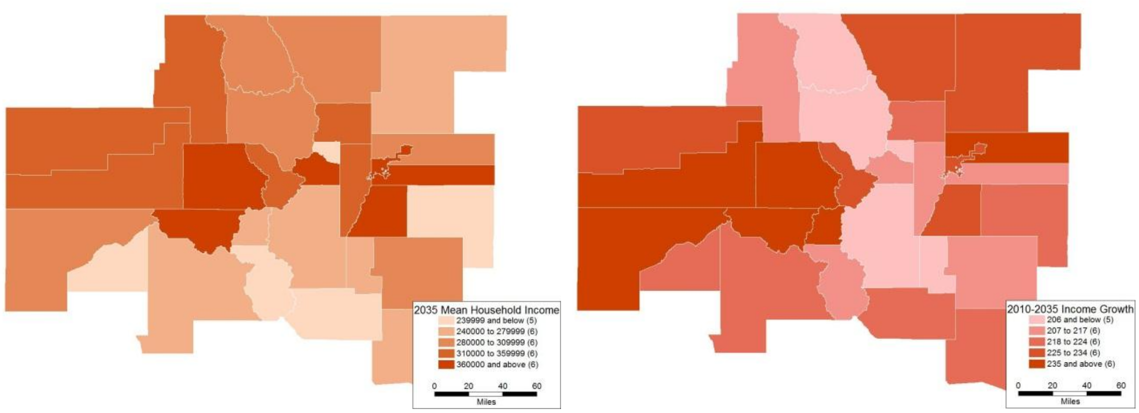


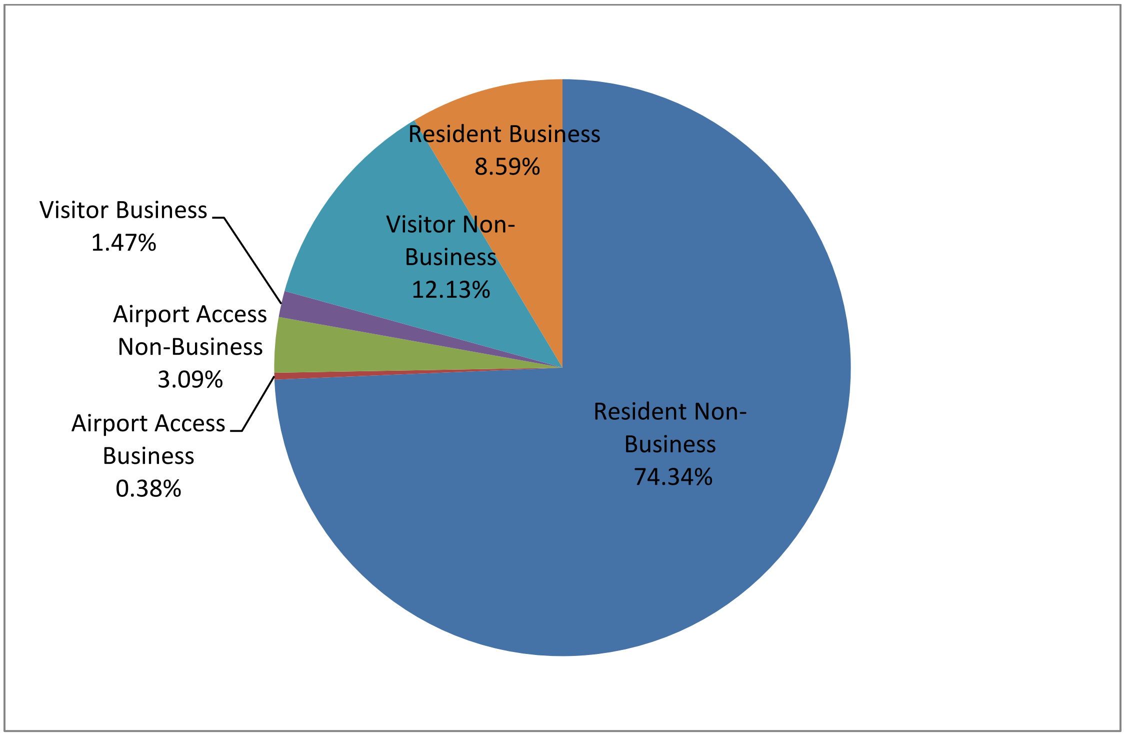
FIGURE 6. 2035 MEAN HOUSEHOLD INCOME AND GROWTH BY COUNTY



Market Segments

From the SP survey data, six distinct market segments based on trip purposes are identified for inter-urban travel within the study area. Each traveler is grouped into one of these six market segments – resident non-business, resident business, visitor business, visitor non-business, airport access business and airport access non-business. Figure 7 shows the proportion of travelers in each market segment.

FIGURE 7. PROPORTION OF MARKET SEGMENTS IN STUDY AREA



Trip Tables

Trip tables are critical inputs into the mode choice models that calculate the diversions from the existing inter-urban modes (i.e. auto, air and bus) to the proposed new AGS/Train mode. Separate tables are prepared for auto, bus, and air. The following section describes trip table data sources, zone catchment areas as well as 2011 and 2035 input trips by mode.

Catchment areas

For each of the common carrier modes (AGS/Train, bus), catchment areas are defined for each of the train stations and bus stops. The catchment size varies by mode to reflect representative access/egress distances. For AGS/Train, the catchment areas have radii of approximately 50 miles around the corresponding stations. Bus catchment areas were limited to the city centers, with radii of approximately 5 miles around the bus stops. Trips are distributed to zone pairs in their corresponding catchment area based on zonal population.

Growing base year (2011) trip tables

The base origin-destination trip tables for bus and auto are adjusted to 2035 trips by applying growth factors calculated from the auto direct demand models described later. The direct demand models produce distinct year-to-year growth factors for each zone pair. Air trips are grown to 2035 using growth in enplanements as provided in the Federal Aviation Administration (FAA) Terminal Area Forecasts (TAF).

Auto trip table development

Base year (2011) OD auto trips are developed based on data from cell phone movements in the study area. This data was obtained from AirSage, a company that tracks anonymous cell phone movement. Detailed discussion on the AirSage data and development of the base year inter-urban auto trip tables is included in Section 3: New Original Data Collection. For the long distance inter-urban market, only trips of 50 miles or longer are considered candidate trips that may divert to the AGS/Train mode. Based on the market segment definitions described above, the auto trip tables are separated into four trip purposes first: resident non-work, resident work, visitor, and airport access with the visitor and airport access trips further segmented into business and non-business.

The trip tables are also divided into captive and non-captive trips. Captive trips are defined as auto trips that need to make en-route stops, thus requiring an automobile for the entire length of the trips. These trips are therefore not considered eligible for diversion to AGS/Train and are removed from the trip table before application of the mode choice model. As illustrated in Table 4, the percentage of captive trips varies by trip purpose. This information is obtained from the Stated Preference survey as well.

TABLE 4. CAPTIVE TRIPS BY TRIP PURPOSE

Trip Purpose	Percent Captive Trips
Local non-work	24%
Local work	20%
Visitor	22%
Airport Access	20%

Additional criteria are used to calculate the auto trips that are eligible for diversion to the AGS/Train mode. These criteria, used to calculate the “in-scope” automobile travel demand in the study area, include:

- All trips less than 50 miles are removed from the inter-urban trip tables; and

TRIPS WHERE THE SUM OF ACCESS AND EGRESS DISTANCE EXCEED AUTO DISTANCE AND/OR LINE-HAUL HAUL AGS/TRAIN DISTANCE ARE REMOVED FROM THE TRIP TABLES. BECAUSE ACCESS AND EGRESS CHARACTERISTICS VARY BY AGS/TRAIN SCENARIOS THAT ARE ANALYZED, THE NUMBER OF TRIPS ELIGIBLE ELIGIBLE FOR DIVERSION IN THE INTER-URBAN MODE CHOICE MODEL ALSO CHANGES ACCORDINGLY BETWEEN SCENARIOS.

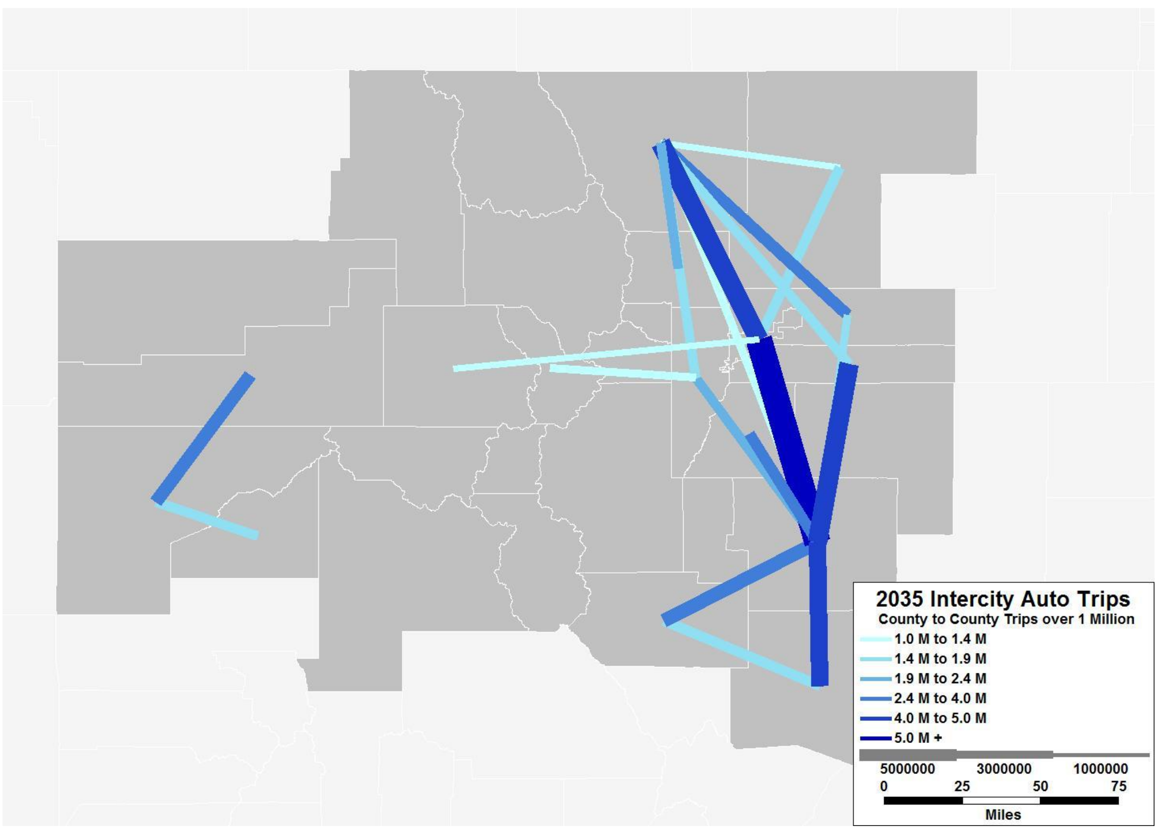
Table 5 shows the overall inter-urban auto trips split by trip purpose after trips with distances less than 50 miles are removed. It does not exclude en-route captive trips, or trips removed based on access/egress distance criteria described in the preceding text.

Table 5. Input auto trips by purpose

Purpose	2011 Base Trips (Millions)	2035 Forecast Trips (Millions)	2011-2035 CAGR
Local non-work	108.9	130.0	0.74%
Local work	13.1	15.4	0.70%
Visitor	21.1	25.6	0.82%

Figure 8 illustrates 2035 county to county input trips; only volumes that exceed 1 million trips are displayed. As shown in Figure 8 below, the highest volume of trips occurs between I-25 south and Denver, followed by I-25 north and Denver.

Figure 8. Inter-urban auto trips



Bus trip table development

Supply side information (i.e. frequency of service) from operators' websites and capacity and load factor assumptions are used to estimate inter-urban bus trip volumes by station pair. Greyhound and FLEX are the only bus services considered. The station-pair level trips estimated from this analysis are distributed to zones within 5 miles of each station, the assumed catchment area for bus trips. The resulting base year OD trip tables are grown to 2035 using growth factors from the auto direct demand model, as no specific direct demand model is developed for bus. Base and future input bus trips are shown in Table 6.

TABLE 6. INPUT BUS TRIPS

2011 Base Trips (Millions)	2035 Forecast Trips (Millions)	2011-2035 CAGR
0.30	0.40	1.21%

Air trip table development

The study area is served by a large hub airport, the Denver International Airport (DEN), and three regional airports in Colorado Springs (COS), Eagle County (EGE) and Pueblo (PUB)[4]. Table 7 sets out a number of key characteristics of each of these airports, including its ranking among US airports in terms of 2011 domestic passenger enplanements, scheduled departures, passenger carriers operating at the airport, and enplanements per departure.

Denver International Airport is located to the northeast of Denver, approximately 25 miles by car from the city center. It is the fourth busiest airport in the US, and a major hub for United Airlines, low-cost carrier Frontier Airlines and commuter carrier Great Lakes Airlines. It is also well served by Southwest Airlines. The airport functions as a gateway to the Colorado Rocky Mountain region, and is a major destination for domestic and international flights, as well as a connecting point for many longer-distance air trips. Colorado Springs Airport (COS), which is the second busiest airport in Colorado, and the other airports in the study area (EGE and PUB), are primarily served by feeder flights to DEN and other hubs; this obliges passengers traveling to other destinations to make a connection at these hubs.

TABLE 7. AIRPORT CHARACTERISTICS

Code	Airport	US Airport Rank	2011 Passenger Enplanements	2011 Scheduled Departures	2011 Passenger Carriers	Enplanements per Departure
DEN	Denver International, CO	4	24,462,500	295,154	27	83
COS	Colorado Springs, CO	93	849,000	15,696	16	54
EGE	Eagle County Regional, CO	180	196,000	2,321	5	84
PUB	Pueblo Memorial, CO	320	14,500	1,155	8	13

Source: Airport Snapshots from www.bts.gov

Table 8 shows the total number of true origin-destination (i.e. end to end, not connecting) trips between study area airport pairs by direction, with outbound passenger volumes shown to the

[4] Fort Collins Loveland Municipal Airport (FNL) is primarily used for general aviation - the only commercial air service is provided by Allegiant Travel Company, with roundtrip service to Las Vegas and Phoenix-Mesa. This airport does not serve any scheduled airline passengers within Colorado, and therefore will not be considered for further analyses.

left of the diagonal and inbound passenger volumes shown to the right of the diagonal. The data shown here is as reported in the DB1B airline ticket sample database, without additional processing.

TABLE 8. 2011 ORIGIN-DESTINATION AIR TRIPS BY DIRECTION

	Destination (To)			
Origin (From)	Colorado Springs (COS)	Denver Intl. (DEN)	Eagle County (EGE)	Pueblo Other
COS		3,290	10	50
DEN	4,610		1,170	14,870
EGE	10	990		
PUB Other	40	14,070		

Source: DB1B Market data for number of passengers between airport pairs for 2011 Q1 to 2011 Q4, extracted from www.bts.gov

Level of Service (LOS) Characteristics

The LOS characteristics for any modes (e.g. time, cost, service frequency) affect individuals' choice of travel mode. Consequently, LOS characteristics are critical in predicting ridership and revenue for a new mode. This section describes in detail the LOS characteristics, sources, and assumptions for each mode considered for the inter-urban travel market.

Auto LOS characteristics

Auto LOS characteristics include travel time, distance, and toll cost between all the zone pairs in the study area. LOS characteristics are obtained from the projected 2035 highway network that is created for this study from the study area MPO models as well as the PEIS study. The highway network thus created contains segment-level data on speed, distance, and toll cost. The highway route/path between each zone pair is determined by minimizing the generalized cost of all the possible paths. Corresponding auto travel times, distances, and toll costs are calculated for the selected path between all zone pairs using data from the highway network. The generalized cost function used for this purpose is shown below.

$$GC = (t * VOT) + (d * oc) + tc$$

> where GC is generalized cost in 2012 \$; t is time in minutes; *VOT* is value of time; *d* is distance; *oc* is vehicle operating cost per mile in 2012\$, and *tc* is toll cost in 2012 \$.

In the generalized cost function shown above, auto value of time is assumed to be \$12.00/hour[5]. Per mile auto operating costs (~\$0.16/mile) are calculated from historical and projected fuel

[5] Value from the DRCOG model

price and fuel price efficiency data obtained from the Energy Information Administration (EIA) website, shown in Table 9. This operating cost values is used for all the non-business and/or non-work related travel for the study. For business and/or work related travel, an operating cost per mile value of $0.32/mile is used to represent higher perceved out-of-pocket auto costs for the travelers in these market segments.

TABLE 9. AUTO OPERATING COSTS

Auto operating cost business	$0.32/mile
Auto operating cost non-business	$0.16/mile

Auto travel time

Travel time is calculated from the speed and distance data associated with the highway network. The congested or AM peak speed is used to calculate auto travel time; otherwise, free flow speed is assumed. The speed fields used to calculate time in the inter-urban model are shown in Table 10.

Four of five highway networks used for this study, as mentioned above, provide highway networks and corresponding data for forecast year 2035, and therefore do not require travel time adjustments. However, the PEIS provides travel times for year 2025 only, so highway travel times obtained from the PEIS highway network are increased by 20% in order to take into account of changing congestion conditions between 2025-2035. The assumption of 20% is based on the percentage increase in vehicle hours traveled between 2025-2035 in the DRCOG travel demand model.

TABLE 10. SPEED ASSUMPTIONS BY TRAVEL DEMAND MODEL

Model	Network Year	Congested Speed Field	Adjustments
I-25 North EIS	2035	AM Peak	None
DRCOG	2035	AM Peak	None
PPACOG	2035	AM Peak	None
PACOG	2035	Free Flow	None
PEIS	2025	Congested	20% increase over 2025 travel time

To get the travel time for each zone pair, the average of both directional travel times is assumed to represent average daily conditions. Table 11 shows approximate auto distance, travel time, and auto cost assumptions for select station pairs in 2035.

TABLE 11. AUTO DISTANCES AND TRAVEL TIMES IN 2035

City Pair	Distance (miles)	Travel Time (minutes)
DIA-Eagle	156.3	214.0
Fort Collins-Eagle	190.6	261.3
Colorado Springs-Eagle	191.7	257.3
Fort Collins-Colorado Springs	136.0	198.3

Auto cost

Auto cost is the sum of vehicle operating cost, toll cost, and parking cost. In order to convert auto cost per vehicle to auto cost per person, auto cost is divided by the average auto occupancy, or travel group size (as shown in Table 12), obtained from the Stated Preference survey. Auto occupancy factors vary by trip purpose. These vehicle occupancy values were cross-checked against similar data from the recently concluded Front Range Travel Survey (FRTS) and found to be quite comparable. Figure 9 illustrates auto cost per person by trip purpose for major station pairs.

FIGURE 9. AUTO COST PER PERSON BY TRIP PURPOSE

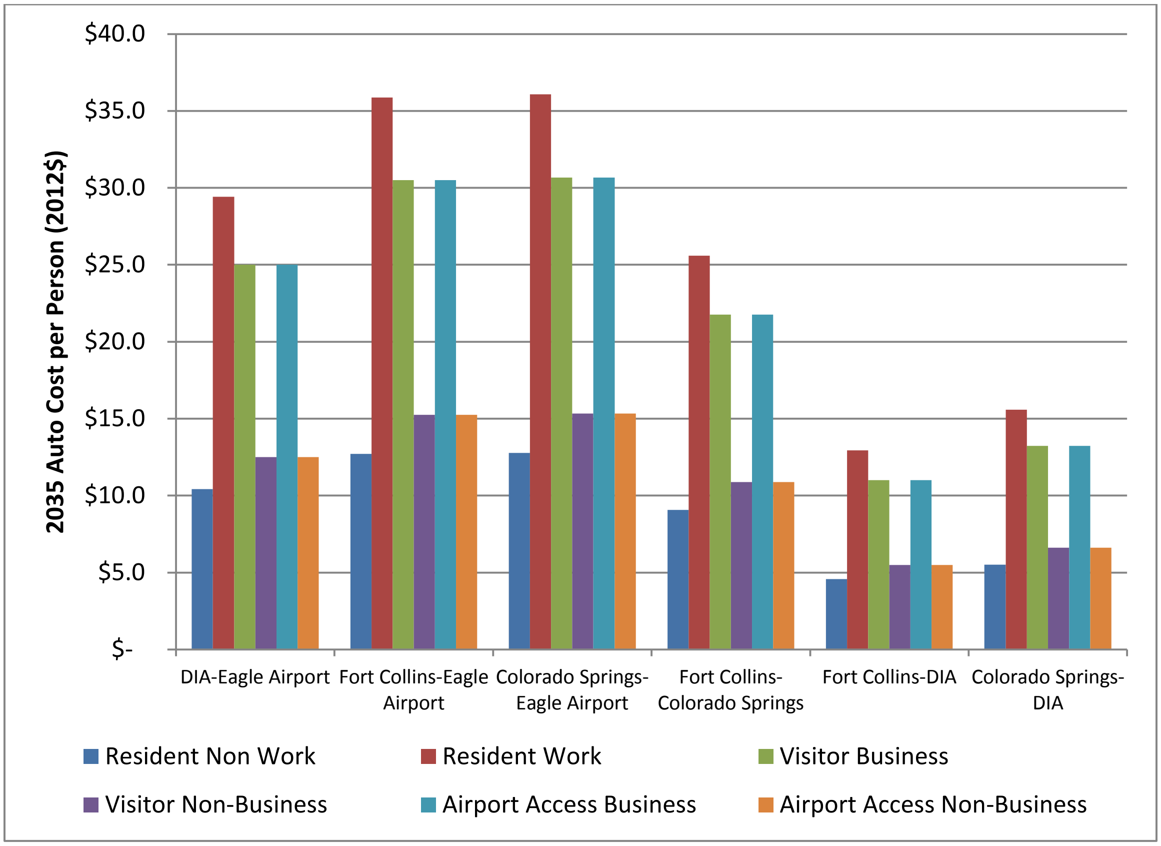


TABLE 12. AUTO OCCUPANCIES BY TRIP PURPOSE

Purpose	Auto Occupancy
Local non-work	2.4
Local work	1.7
Visitor	2.0
Airport Access	2.0

Rail LOS characteristics

The AGS/Train LOS characteristics are critical input data necessary to forecast AGS/Train mode shares, and in turn 2035 ridership and revenue. The inter-urban mode choice model estimates a traveler's utility from using the AGS/Train, auto, bus and air for travel between each OD pair in the study area. In other words, the utility is a function of the LOS variables for travel between an origin and destination via each mode. As explained in the mode choice section, these utilities are used to calculate the shares of each mode – the probability of a traveler choosing a mode depends on the relative utilities of the various modes available for his/her travel.

A person traveling by the AGS/Train (or other common carrier mode) actually has several trip parts - access to an AGS/Train station from an origin zone, accessing the station platform, waiting for the train to arrive, taking the AGS/Train from an origin station to destination station, alighting from the train to go a departure point within the station, and the ultimate egress from the destination station to a destination zone. In the mode choice models, each zone is assigned to the closest station in terms of shortest travel time, such that each zone pair is associated with a nearby station pair to fulfill the trip by the AGS/Train option. To account for all the trip parts mentioned above, the AGS/Train utility in the mode choice models is a function of rail in-vehicle time, transfer time, terminal times (both access and egress), fare and frequency (in the form of wait time), as well as access and egress time, including the access and egress tolls and the parking costs incurred among other things. Different components of travel times used for rail LOS characteristics are weighted differently in the mode choice model, based on how travelers usually perceive them. For example, travelers may perceive wait times to be longer than in-vehicle time. This is discussed more in The Mode Choice Models section.

Rail in-vehicle time

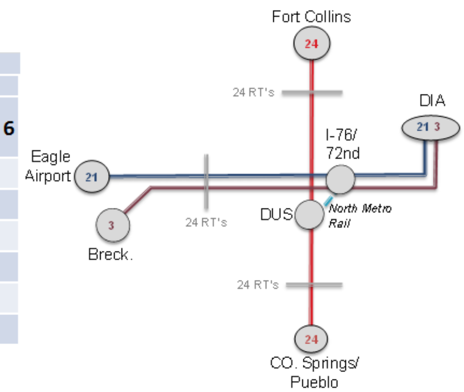
Station to station AGS/Train in-vehicle times are calculated from timetables developed by other team members for each operating scenarios using train simulation or similar models. Using the zone to station correspondence, each zone pair is assigned the rail in-vehicle time of the station pair it is associated with. The following paragraphs present a brief summary of each scenario, along with the station pair travel time comparisons. None of the scenarios provides a one-seat ride between north-south and east-west stations. Any such trip involves a transfer and hence constitutes a two-seat AGS/Train ride. Transfer times vary significantly by scenario, as the transfers are sometimes within the same station and sometimes involve taking a separate transit mode from one AGS/Train station to another. The end-to-end station pair level AGS/Train in-vehicle time used in the modeling appropriately takes into account the transfer time involved, if any. However, for simplicity, the discussion in this section does not incorporate the transfer times; they are discussed later.

The A-1 operating scenario has two east-west alignment options through the Denver area. In A-1 option a (A-1a), the downtown Denver station is located at the I-76/72nd Street station, while in A-1 option b (A-1b), it is located at the Denver Union Station. Both the north-south and east-west alignments pass through the downtown Denver area. The east-west alignment through the I-76/72nd Street station is slightly shorter, and as a result has slightly faster travel times. Figure 10 shows a schematic of the operating plan, as well as the travel time comparisons with auto for some of the key station pairs. The A-1a/I-76 scenario is better than the A-1b /US 6 scenario for travel from stations in the Denver area (DEN) to stations in the I-70 corridor (I-70), for example DIA to Eagle airport, and worse by about a minute for travel from stations in the I-25 north and I-25 south areas to I-70: for example, Fort Collins to Eagle airport, and Colorado Springs to Eagle Airport. Travel times from I-25N to I-25S are the same in both scenarios, and about three minutes shorter in the A-1a/I-76 scenario for travel from I-25N and I-25S to DEN.

On average, compared to the auto mode, travel times between stations via the AGS/Train are halved.

FIGURE 10. SCENARIO A-1 TRAVEL TIME COMPARISON VERSUS AUTO

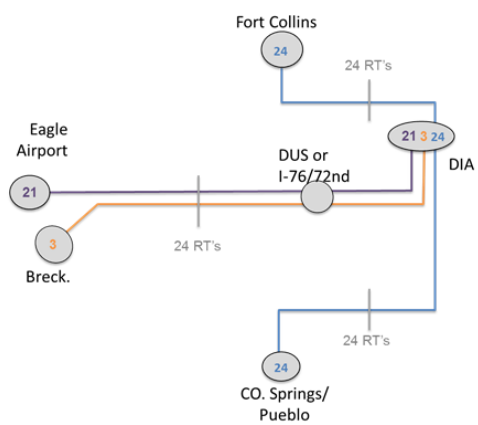
Scenario A-1 (I-76 or US 6)				
		Travel Time (minutes)		
Region Pair	Station Pair	Auto	A-1a/I-76	A-1b/US 6
DEN - I-70	DIA-Eagle Airport	214	94	96
I-25N - I-70	Fort Collins-Eagle Airport	261	121	120
I-25S - I-70	Colorado Springs-Eagle Airport	257	138	137
I-25N - I-25S	Fort Collins-Colorado Springs	198	93	93
I-25N - DEN	Fort Collins-DIA	102	49	52
I-25S - DEN	Colorado Springs-DIA	104	66	69



Similarly, the A-5 scenario has two east-west alignment options through the downtown Denver area – A-5a through Denver Union Station and A-5b through the I-76/72nd Street station. Figure 11 shows a schematic of the operating plan, as well as the travel time comparisons with auto for some of the key station pairs. In both A-5 scenarios, the north-south alignment by-passes the downtown Denver area, and goes around through DIA. The travel times are about a minute faster in the A-5a/I-76 scenario for travel to I-70 from DEN, I-25N and I-25S. The travel times between stations on the north-south corridor are exactly the same because the alignment goes through DIA. On average, auto travel times between stations are double that of the AGS/Train.

FIGURE 11. SCENARIO A-5 TRAVEL TIME COMPARISON VERSUS AUTO

Scenario A-5 (I-76 or US 6)				
		Travel Time (minutes)		
Region Pair	Station Pair	Auto	A-5a/I-76	A-5b/US 6
DEN - I-70	DIA-Eagle Airport	214	95	96
I-25N - I-70	Fort Collins-Eagle Airport	261	132	133
I-25S - I-70	Colorado Springs-Eagle Airport	257	152	153
I-25N - I-25S	Fort Collins-Colorado Springs	198	94	94
I-25N - DEN	Fort Collins-DIA	102	37	37
I-25S - DEN	Colorado Springs-DIA	104	57	57



As seen in Figure 12, the north-south and east-west alignments in scenario B-2a and scenario B4 both present interesting operating plan options by bypassing the downtown Denver area. While the north-south alignment goes through DIA in both scenarios, the east-west alignment goes through the I-25S area in B-2a, and through the I-25N area in B4. As such, while the travel times are exactly the same between stations on the north-south corridor, B-2a offers quicker and direct travel options from I-70 to I-25S, whereas B4 offers the same from I-70 to I-25N. Additionally, B4 travel times are slightly better between DIA and I-70. Table 13 compares the travel times between both scenarios and auto for some of the key station pairs. Both scenarios offer significant time savings compared to auto.

FIGURE 12. SCENARIO B-2A AND B4 OPERATING PLAN SCHEMATIC

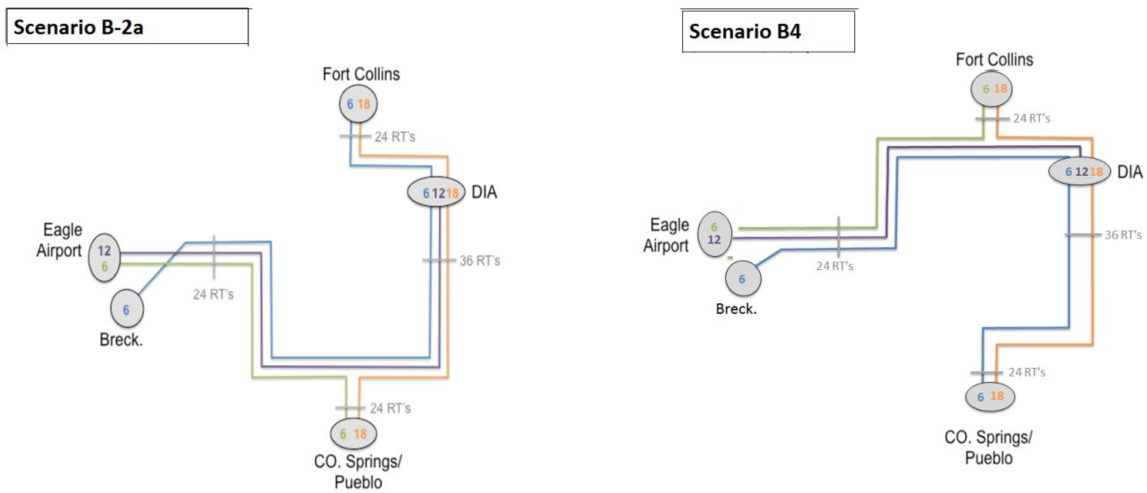


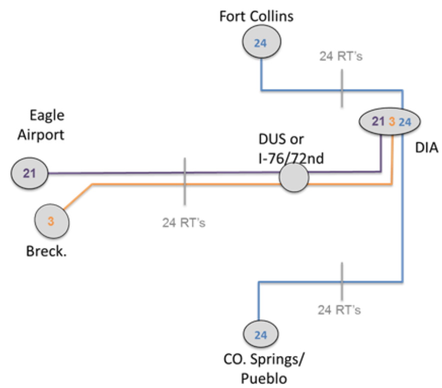
TABLE 13. B-2A AND B4 TRAVEL TIME COMPARISON VERSUS AUTO

Scenario B-2a and B4				
Region Pair	Station Pair	Travel Time (minutes)		
		Auto	B-2a	B4
DEN - I-70	DIA-Eagle Airport	214	112	109
I-25N - I-70	Fort Collins-Eagle Airport	261	149	119
I-25S - I-70	Colorado Springs-Eagle Airport	257	124	166
I-25N - I-25S	Fort Collins-Colorado Springs	198	94	94
I-25N - DEN	Fort Collins-DIA	102	37	37
I-25S - DEN	Colorado Springs-DIA	104	57	57

Another operating scenario uses the exact same A-5a option with exact same frequencies but with Maglev technology from the West Suburban station to points further west on the I-70 corridor. While the A-5a scenario operates on high-speed steel wheel technology on all sections, the A-5a Maglev runs on Maglev on the I-70 corridor, and on high-speed steel wheel in all other sections of the alignment. Consequently, the travel time between I-25N, I-25S and DIA are the same in both scenarios, but are about four minutes faster between I-70 and I-25N and I-25S, as summarized in Figure 13.

FIGURE 13. SCENARIO A-5A AND A-5A MAGLEV COMPARISON VERSUS AUTO

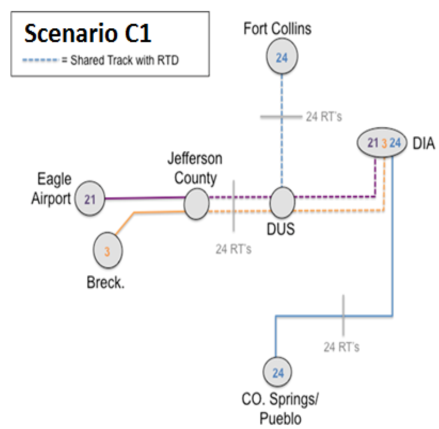
Scenario A-5a and A-5a Maglev				
Region Pair	Station Pair	Travel Time (minutes)		
		Auto	A-5a	A-5a Maglev
DEN - I-70	DIA-Eagle Airport	214	95	99
I-25N - I-70	Fort Collins-Eagle Airport	261	132	136
I-25S - I-70	Colorado Springs-Eagle Airport	257	152	156
I-25N - I-25S	Fort Collins-Colorado Springs	198	94	94
I-25N - DEN	Fort Collins-DIA	102	37	37
I-25S - DEN	Colorado Springs-DIA	104	57	57



Scenario C1 shares track with RTD in the Denver and I-25N areas and consequently runs considerably slower, as seen in Figure 14. Compared to auto, the travel times are about half between I-25S and DIA, but not as significantly different between station pairs on the shared track.

FIGURE 14. SCENARIO C1 TRAVEL TIME COMPARISON VERSUS AUTO

Scenario C1			
Region Pair	Station Pair	Travel Time (minutes)	
		Auto	C1
DEN - I-70	DIA-Eagle Airport	214	128
I-25N - I-70	Fort Collins-Eagle Airport	261	148
I-25S - I-70	Colorado Springs-Eagle Airport	257	183
I-25N - I-25S	Fort Collins-Colorado Springs	198	133
I-25N - DEN	Fort Collins-DIA	102	78
I-25S - DEN	Colorado Springs-DIA	104	55



Transfer time

On the AGS/Train, a transfer is always involved when traveling between the north-south and the east-west alignments. In the A-5 (A-5a, A-5b, A-5a Maglev) and C1 scenarios, the transfer occurs at DIA and Denver Union station (DUS), respectively, and adds an additional 22.5 minutes to the end-to-end rail trip (Figure 15). Additionally, in C1, passengers encounter a 22.5 minute transfer at DUS for a trip between I-25N and DIA, and a total of 52.5 minutes transfer at DUS and DIA for trips between I-25N and I-25S. In the B-2a and B4 scenarios, the north-south to east-west transfer also takes place at DIA, and adds an additional 30 minutes to the end-to-end travel time. A 22.5 minutes transfer time at DUS is added on in the A-1b scenario between I-25N/I-25S and I-70/DIA as well. For the A-1a scenario, transferring is more cumbersome because passengers are required to transfer between two physically separate stations (DUS and I-76/72nd

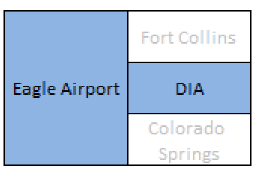
Street station) using the North Metro Rail. Hence, a 52.5 minute transfer time is assumed between -25N/I-25S and I-70/DIA for this scenario.

FIGURE 15. STATION PAIR TRANSFER TIME BY SCENARIO

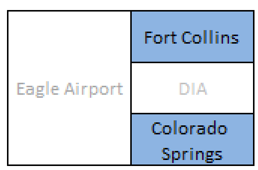
Region Pair	Station Pair	Transfer Time (minutes)								
		Auto	A-1a	A-1b	A-5a	A-5b	C1	B2-A	B4	A-5a Maglev
DEN - I-70	DIA - Eagle Airport	-	-	-	-	-	-	-	-	-
I-25N - I-70	Fort Collins - Eagle Airport	-	52.5	22.5	22.5	22.5	22.5	30	-	22.5
I-25S - I-70	Colorado Springs - Eagle Airport	-	52.5	22.5	22.5	22.5	22.5	-	30	22.5
I-25N - I-25S	Fort Collins - Colorado Springs	-	-	-	-	-	52.5	-	-	-
I-25N - DEN	Fort Collins - DIA	-	52.5	22.5	-	-	22.5	-	-	-
I-25S - DEN	Colorado Springs - DIA	-	52.5	22.5	-	-	-	-	-	-

While the A-1a and A-5a/I-76 in-vehicle travel times are slightly better than in the A-1b and A-5b/US-6, transfer times at the I-76/72nd Street station are much worse than at DUS. Of the eight operating plan scenarios, A-1b, A-5b, B-2a and B4 offer the most significant travel time savings over auto. Figure 16 presents total end-to-end travel times (including transfer time for the AGS/Train option) between Eagle Airport, DIA, Fort Collins and Colorado Springs for the auto and the AGS/Train options. Compared to auto, the B-2a scenario consistently offers better end-to-end travel times savings, followed by B4 and then A-5b.

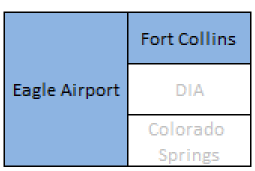
FIGURE 16. STATION PAIR END-TO-END TRAVEL TIMES BY SCENARIO VERSUS AUTO



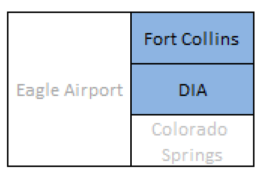
Scenario Name	Travel Time (minutes)
Auto	214
A-1b	**96**
A-5b	**96**
B-2a	112
B4	109



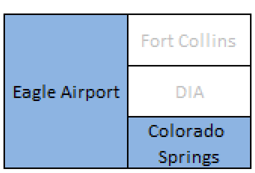
Scenario Name	Travel Time (minutes)
Auto	198
A-1b	93
A-5b	94
B-2a	94
B4	94



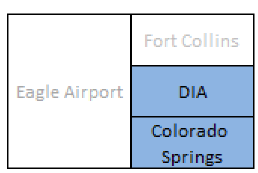
Scenario Name	Travel Time (minutes)
Auto	261
A-1b	143
A-5b	156
B-2a	179
B4	**119**



Scenario Name	Travel Time (minutes)
Auto	102
A-1b	75
A-5b	**37**
B-2a	**37**
B4	**37**



Scenario Name	Travel Time (minutes)
Auto	257
A-1b	160
A-5b	176
B-2a	**124**
B4	196



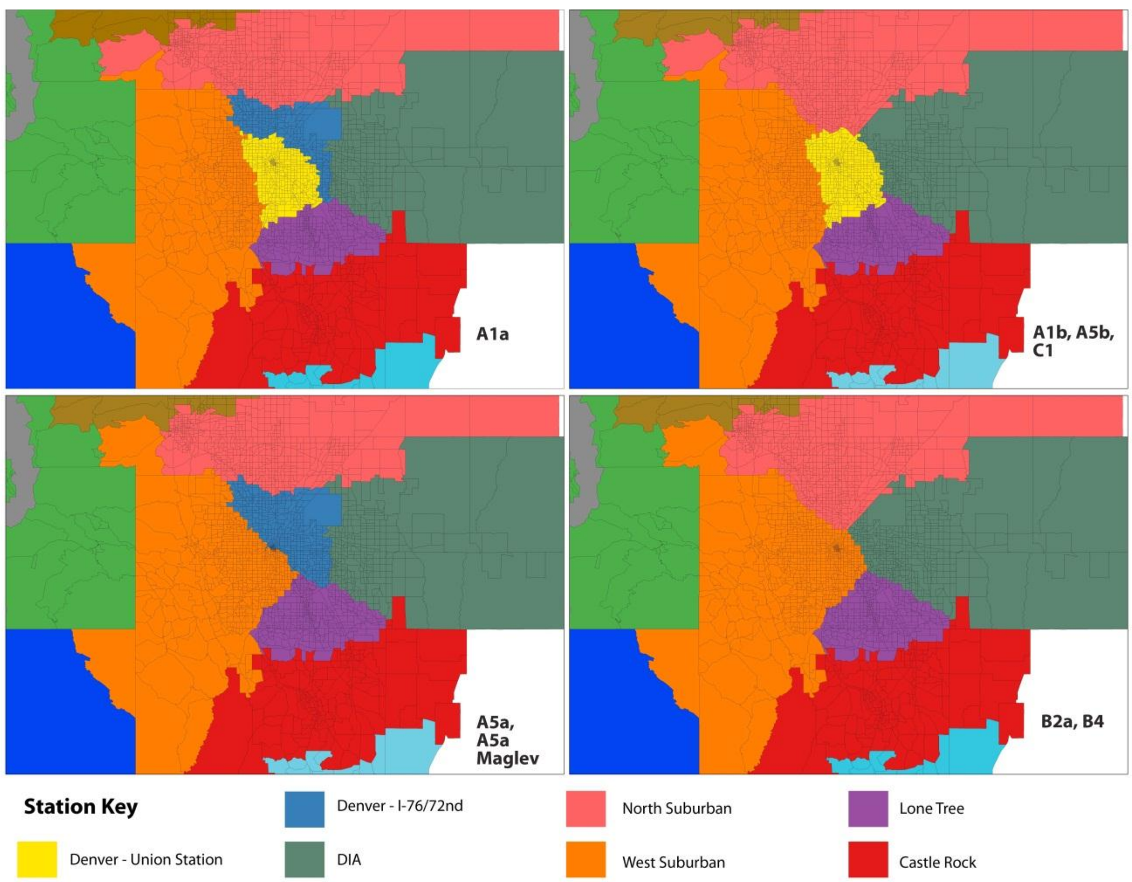
Scenario Name	Travel Time (minutes)
Auto	104
A-1b	92
A-5b	**57**
B-2a	**57**
B4	**57**

Access and egress time

Each zone in the study area is assigned an AGS/Train station that is closest to it in terms of shortest travel time, thus zone pairs are assigned LOS characteristics of the station pairs they are associated with. In the event of an unrealistic zone to station assignment, the process is refined by making manual adjustments.   Auto characteristics are used to obtain AGS/Train station access/egress times assuming auto access for the inter-urban market.

Just as is done to develop auto OD distances and times, zone-to station access times and distances, and station-to-zone egress times and distances are extracted from highway network skims. The zone-to-station assignment is updated for each scenario to reflect changes in the operating plan across each scenario. While there are some changes in the zone to station correspondence in the I-70, I-25N and I-25S regions, the major changes occur in the Denver area. When a scenario has no downtown Denver stations, the catchment area of the surrounding stations enlarge, for example in scenarios B-2a and B4, the downtown Denver zones are assigned to the North Suburban, West Suburban, and Lone Tree catchment areas. In A-5a, the downtown Denver zones are assigned to the I-76/72nd Street station, while in the A-1b, A-5b and C1 scenario, the same zones are assigned to the Denver Union Station as seen by the changes in the catchment areas depending on scenarios in Figure 17.

FIGURE 17. DOWNTOWN DENVER CATCHMENT AREA BY SCENARIO



Frequency/wait time

The AGS/Train frequencies are summarized in the Table 14. In the mode choice model, the train frequencies are converted to time equivalents to represent how long on average a person would wait at a station before a train arrived. As expected, the wait time decreases as train frequency increases. For the mode choice model, the wait time is calculated as 1/4th of the train headway and was capped at 30 minutes.

TABLE 14. STATION PAIR AGS/TRAIN DAILY FREQUENCY

Region Pair	Station Pair	Frequency							
		A-1a	A-1b	A-5a	A-5b	C1	B2-A	B4	A-5a Maglev
DEN - I-70	DIA - Eagle Airport	21	21	21	21	21	12	12	24
I-25N - I-70	Fort Collins - Eagle Airport	21	21	21	21	21	12	6	24
I-25S - I-70	Colorado Springs - Eagle Airport	21	21	21	21	21	6	12	24
I-25N - I-25S	Fort Collins - Colorado Springs	24	24	24	24	24	18	18	24
I-25N - DEN	Fort Collins - DIA	24	24	24	24	24	24	24	24
I-25S - DEN	Colorado Springs - DIA	24	24	24	24	24	18	24	24

AGS/Train costs

The total costs to travel by the AGS/Train option from an origin zone to a destination zone include the auto operating cost of accessing and egressing a station, access and egress toll costs, parking costs at stations (if any), and the AGS/Train fare between the origin and destination stations. Costs are always expressed as per-person cost. Hence, excluding the fares, the remaining cost is divided by the average auto travel group size, which is estimated from the Stated Preference survey. The station pair fare is the major driver of the cost of traveling via the AGS/Train. Station pair fares are calculated based on the station pair distances and a distance based fare assumed to be $0.35 per mile.

Figure 18 compares the end-to-end total per-person costs between representative origin and destination stations for the inter-urban auto and AGS/Train modes in the resident non-business market. Figure 19 shows a similar comparison for the resident business market. Even though the station pair level AGS/Train fares are the same across market segments, the auto operating cost per person varies by market segment type. For the same station pair, the auto operating cost per person is lowest in the resident non-business market and highest in the resident business market. As explained in the auto LOS section, the auto operating cost is calculated based on distance, assuming an operating cost of $0.32 per mile for the business markets, and $0.16 per mile for the non-business markets. The auto cost is typically significantly lower than the AGS/Train fare between any given OD pair.

Parking cost and access/egress travel cost are the other LOS variables that influence the cost component of a person's utility in the mode choice model. Current daily parking costs at each rail station are multiplied by the average AGS/Train trip duration (which varies by market segment), obtained from the Stated Preference survey. The percentage of AGS/Train travelers who park at stations is also obtained from the survey. Station pair parking cost is estimated by averaging the parking costs of the origin and destination stations. For the access and egress auto operating cost and toll cost, auto travel characteristics are used. Just as was done to develop auto OD costs, zone-to station auto access costs, station-to-zone auto egress costs, and access and egress toll costs are extracted from highway network skims.

FIGURE 18. STATION PAIR RESIDENT NON-BUSINESS COST COMPARISON VERSUS AUTO

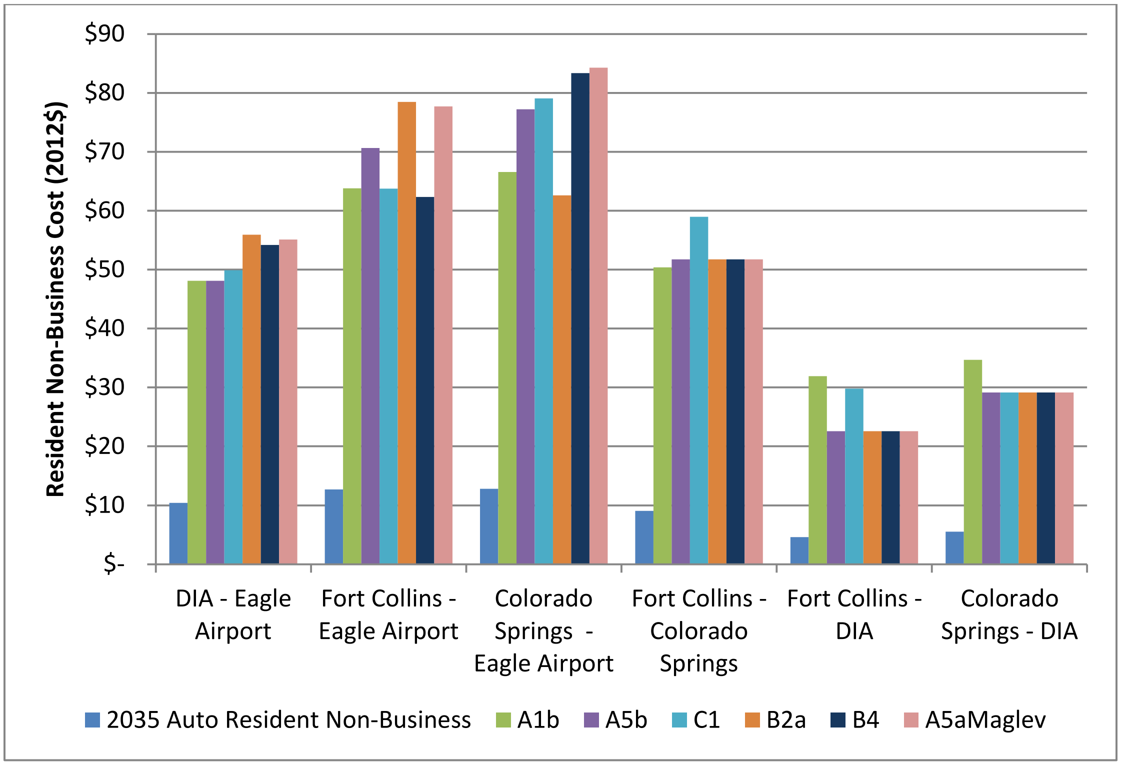
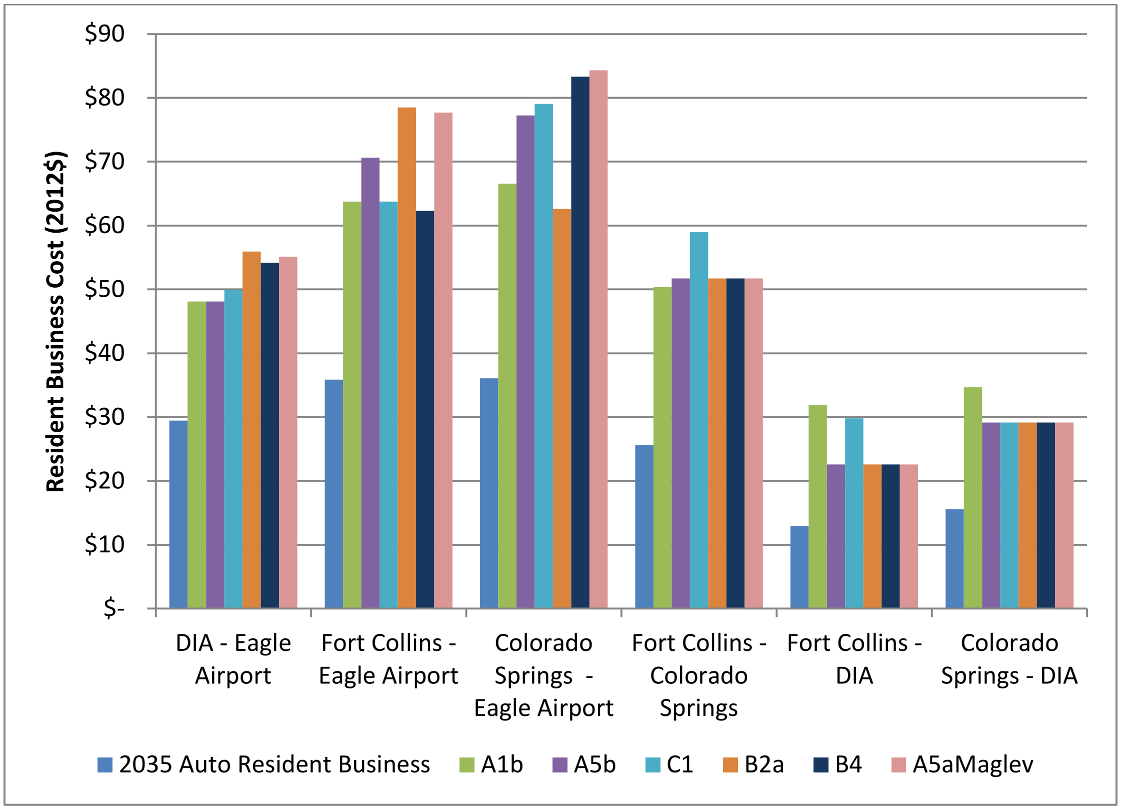


FIGURE 19. STATION PAIR RESIDENT BUSINESS COST COMPARISON VERSUS AUTO



Bus level of service

Bus station pair level travel time, distance, fare, and frequency are based on published schedules from operators' websites. Options that require transfers at intermediate bus stations to travel from origin to destination are not considered because it is less likely to occur as a result of unrealistic end-to-end travel times. Table 15 presents present one-way bus LOS characteristics for three representative station pairs. In addition to these characteristics, access/egress time and cost, parking cost (all based on auto costs), and access/egress terminal time are also inputs into the bus model.

TABLE 15. BUS LOS CHARACTERISTICS

City Pair	In-Vehicle Travel Time (Minutes)	Frequency	Fare (2012$)
DUS-Vail	140	2	$35
DUS-Colorado Springs	86	5	$15
DUS-Fort Collins	75	2	$23

All Bus LOS characteristics for 2035 are assumed to be the same as at present, except for station access/egress characteristics, which are determined using the 2035 highway network developed from MPO travel demand models, described in more detail in the auto LOS section.

Forecasting Models

As discussed earlier, three sets of models are used to produce the ridership and revenue forecasts for the inter-urban travel market. These include:

- The growth models: Used to calculate the growth rates for the modal trip tables to grow them to the year 2035;
- The mode choice models: Used to calculate the modal shares for each mode (including the AGS/Train option) in 2035; and
- The induced demand model: Used to calculate inter-urban induced demand (new demand that only materialize in the presence of the AGS/Train mode) for the AGS/Train mode.

Following paragraphs describe each of these separately in more detail.

Growth Models

Inter-urban auto travel growth factors are estimated using an auto direct demand model that is developed specifically for this study. Travel growth factors are calculated as the ratio of 2035 to 2011 auto volumes predicted by the direct demand model. These factors are then applied to the 2011 inter-urban auto OD trip tables developed from the cell phone movement based data to grow them to 2035. This incremental application method has the great advantage of closely tying predicted 2035 modal volumes to the 2011 volumes.

Bus travel growth factors are derived from the auto direct demand model as well, as separate direct demand models could not be estimated from the limited data available for the bus mode.

In general, direct demand (growth) models are estimated using the following input data:

- base year auto trip tables by travel purpose;
- socio-economic data (population, income, employment); and
- auto LOS characteristics at the OD pair level.

The direct demand model had the following functional form:

$$Auto\,Volume\ _{OD}^{year\ 2011} = \alpha * {POP_{OD}^{2011}}^{\beta_1} * {EMP_{OD}^{2011}}^{\beta_2} * {LOS_{OD}^{2011}}^{\beta_3} * exp(-LOS_{OD}^{2011}/\beta_4) \ * Denver^{\beta_5}$$

where

$$POP = \sqrt{POP_O^{2011} * POP_D^{2011}}$$

$$EMP = \sqrt{EMP_O^{2011} * EMP_D^{2011}}$$

LOS: generalized cost of traveling between the OD pair: includes auto congestion, travel time, fuel, and toll costs;

$Denver$: constant representing the presence of Denver as a large city

Income is highly correlated with employment, so it is not possible to include all three variables in the model. Nevertheless, the high correlation between these variables indicates that population and employment provide an indirect representation of income for the zones used in this study, and therefore serve as a proxy for income. The other inputs to the direct demand model estimation process are socio-economic data obtained from Woods & Poole , and modal LOS data for 2011 developed as part of the study effort.

Table 16 shows the variables and the corresponding coefficients of the direct demand model estimated for the auto mode.

TABLE 16. AUTO DIRECT DEMAND MODEL COEFFICIENTS

Variable name	Coefficients	
	Values	**t stats**
Constant	6.157	115.058
Ln of population*	.630	343.711
Ln of generalized auto cost	-2.288	-124.452
Generalized auto cost	.043	103.909
Denver dummy	.214	50.916
Ln of employment*	.008	12.150

* Population $= \sqrt{\mathrm{POP}_{\mathrm{O}}^{2010} * \mathrm{POP}_{\mathrm{D}}^{2010}}$ and employment $= \sqrt{\mathrm{EMP}_{\mathrm{O}}^{2010} * \mathrm{EMP}_{\mathrm{D}}^{2010}}$

Source: [SDG analysis]
Note: [Adj. R-sq. = 36%]

Application of the auto direct demand models to forecast year 2035 auto volumes results in an average compound annual growth rate of 0.71% for total auto trips, as shown in Table 17.

TABLE 17. SUMMARY OF BASE AND FORECAST INTER-URBAN AUTO TRIP TABLES

Purpose	2011 Base Trips (Millions)	2035 Forecast Trips (Millions)	2011-2035 CAGR
Visitor	21.28	25.84	0.81%
Local Work	13.26	15.63	0.69%
Local Non-work	110.20	131.35	0.73%
Total	**~149.70**	**~177.28**	**0.71%**

It is difficult to compare the predicted future volume growth in inter-urban trips over 50 miles with historical growth from highway traffic counts because the counts include a mix of short-distance local and long-distance inter-urban travel. Moreover, historical growth rates vary considerably, with periods of high growth during good economic times followed in many cases by negative growth in times of recession. In any event,

Table 18 presents the growth in historical traffic counts at a few representative highway locations (with possible high fractions of longer distance highway travel crossings) in the corridors. The traffic growths as experienced in these selected locations indicate that the growth rates implied by the direct demand model are well within the reasonable range. Moreover, an average annual growth of 0.71% is a reasonable representation of the overall annual growth expected over 30 years.

TABLE 18. HISTORICAL TRAFFIC VOLUMES IN THE STUDY AREA

Year	I-70 E of Wolcott	I-70 W of Georgetown	I-70 E of Idaho Springs	I-25 at Loveland	I-25 S of Castle Rock	I-25 N of Pueblo
2002	21,197	29,052	42,113	66,150	54,073	31,654
2003	21,864	28,395	42,403	61,597	54,276	31,353
2004	22,581	28,544	42,974	61,582	54,494	31,424
2005	23,099	28,863	42,843	67,985	54,537	31,519
2006	23,000	29,298	43,273	66,325	54,443	30,942
2007	23,752	30,485	40,946	64,596	55,068	31,938
2008	24,174	29,629	38,033	64,004	56,204	30,600
2009	23,185	29,296	41,665	N/A	N/A	31,087
2010	22,334	29,245	41,871	N/A	62,473	32,230
2011	22,334	28,984	43,676	68,191	59,474	30,945
2002-2006 CAGR	**2.06%**	**0.21%**	**0.68%**	**0.07%**	**0.17%**	**-0.57%**
2006-2011 CAGR	**-0.59%**	**-0.22%**	**0.19%**	**0.56%**	**1.78%**	**0.00%**
2002-2011 CAGR	**0.58%**	**-0.03%**	**0.41%**	**0.34%**	**1.06%**	**-0.25%**

Mode Choice Models

As described before, Step 1 of the inter-urban travel demand forecasting process calculates the market size in 2035 for all the market segments, assuming that the AGS/Train system is not implemented. In Step 2, the AGS/Train mode shares are calculated using mode choice models developed using SP survey data (described in detail in Section 3: New Original Data Collection) collected during this study. This section describes these inter-urban mode choice models.

Several mode choice models were specified, estimated and tested using the SP survey data. Various model forms were examined, including binary diversion, multinomial logit choice and nested logit choice models; and for the latter, alternative nesting structures were also examined. Based on an assessment of the model estimation results, the following logit model nesting structure is retained for work, non-work and airport access travel purposes:

FIGURE 20. NESTED LOGIT STRUCTURE USED FOR INTER-URBAN MODE CHOICE MODELS

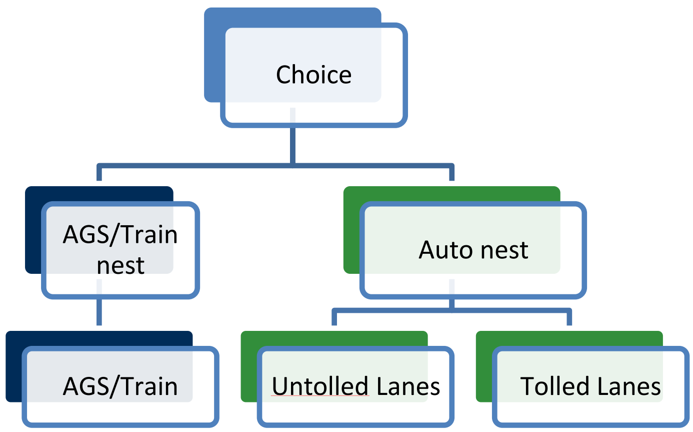


Figure 20 shows the nested logit model structure used for the inter-urban mode choice models to forecast modal shares. It has private auto carrier modes in one nest and the AGC/Train mode in another. Travelers within a nest are more likely to switch to modes within the nest than outside. This reflects the generally greater substitutability of tolled and untolled lanes with each other than with common carrier modes such as AGS/Train.

Keeping the possibility of future tolling options for Colorado highways in mind, it is decided to include the choice of the tolled lanes in the SP data collection and the following mode choice model estimation. However, none of the mode choice model applications in the Level 2 study consider tolled lanes as they are not part of any of the scenarios studied. In effect, this converts the nested multinomial choice model to a binary choice model during the application phase.

Modeling framework: the random utility model

Transportation modelers often use discrete choice models called random utility maximization (RUM) models to forecast mode shares. These mode choice models relate the overall travel utility experienced by users of each mode to the mode's price and service levels, as well as to trip and user characteristics. The general specification of the utility for each mode i is as follows:

$$U_i = V_i + \varepsilon_i$$

where U_i is the utility of mode i, V_i the systematic (or deterministic) part of the utility; and ε_i the stochastic error term.

It is common to use a linear specification for the systematic utility term, in which case the modal utility can be further decomposed as follows:

$$U_i = \alpha_i + \sum_{n=1}^{N} \beta_{in} X_{in} + \varepsilon_i$$

where α_i is the modal constant of mode i;
$\beta_{i1}, \beta_{i2}, \dots, \beta_{iN}$ are mode-specific coefficients for *N* level of service variables (such as in-vehicle time, access time, costs, frequency, on time performance) or socio-economic characteristics (such as income, large cities) for mode i; and
$X_{i1}, X_{i2}, \dots, X_{iN}$ are values of the *N* level of service variables and socio-economic characteristics.

A traditional multinomial logit model for the AGS/Train inter-urban travel mode choice situation assumes that the stochastic error terms are uncorrelated. In this case the probability of choosing the AGS/Train mode (or equivalently the AGS/Train mode share) can be expressed as follows:

$$MNL\ Share_{AGS} = \frac{e^{V_{AGS}}}{e^{V_{free\ auto}} + e^{V_{tolled\ auto}} + e^{V_{AGS}}}$$

In the case of a nested logit (NL) model, groups – or nests – of alternatives are allowed to have correlated error terms, and the formulation is modified. For each nest m, the joint distribution of the error terms of alternatives in the nest has an additional parameter τ_m that is a measure of the mutual correlation of the error terms of those alternatives.

For a nested logit model with M nests, the probability of choosing AGS is expressed as follows:

$$NL\ Share_{AGS\ in\ nest\ m} = \frac{e^{1/\tau_m * V_{AGS}}}{e^{IV_m}} * \frac{e^{\tau_m * IV_m}}{\sum_{j=1}^{M} e^{\tau_j * IV_j}} \text{ where } IV_m = \ln \sum_{k=1}^{K} e^{1/\tau_m * V_k}$$

When estimating the mode choice models for each market segment, a variety of explanatory variables is tested, including separate line-haul (in-vehicle) time, access and egress time, wait time (calculated as $1/4^{th}$ of the headway), travel cost (including vehicle operating cost, parking, tolls and fare), and transfer time at terminals. Combinations of variables are examined, and various interactions between income and the cost variable are tested. Multiple possible travel time specifications are also tested, including different definitions of travel time as combinations of line-haul, access/egress, and wait time. Several market segmentations are also tested. The most satisfactory model specifications are presented next; these are the models that are eventually used for application in the forecasting.

Model coefficients

Mode choice models are estimated for three resident market segments:

- Non-work
- Work and commute
- Airport access

Due to the lack of visitor SP or other relevant data, the visitor model is asserted based on relationships between the estimated models for the other three market segments and based on SDG's previous experience in HSR forecasting studies in the US.

Remarkably, the other (i.e. resident) model coefficients shown in Table 19 are directly estimated from the new SP survey data and do not need to be constrained or otherwise forced to reasonable values. The estimated coefficients are consistent with results that have been found in SDG's previous high-speed rail projects and other HSR studies conducted in the US.

TABLE 19. NESTED LOGIT MODEL COEFFICIENTS

<table>
<tr><th rowspan="2">Nested Logit Models</th><th rowspan="2">Unit</th><th colspan="6">Corridor Residents</th><th rowspan="2">Visitor*</th></tr>
<tr><th>Local Non-Work</th><th>t-stat</th><th>Local Work</th><th>t-stat</th><th>Local Airport Access</th><th>t-stat</th></tr>
<tr><td>In-vehicle Time – Untolled Lanes</td><td>util/min</td><td rowspan="4">-0.0128</td><td rowspan="4">-10.3</td><td rowspan="2">-0.0129</td><td rowspan="2">-3.9</td><td rowspan="2">-0.0298</td><td rowspan="2">-5.6</td><td rowspan="2">-0.0175</td></tr>
<tr><td>In-vehicle Time - Toll Lanes</td><td>util/min</td></tr>
<tr><td>In-vehicle Time – AGS/Train</td><td>util/min</td><td>-0.0148</td><td>-2.4</td><td rowspan="2">-0.0317</td><td rowspan="2">-3.9</td><td>-0.0189</td></tr>
<tr><td>AGS/Train Out of Vehicle Time</td><td>util/min</td><td>-0.0166</td><td>-1.4</td><td>-0.0236</td></tr>
<tr><td>Cost / ln (income / 1,000)</td><td>util/ transformed cost in 2012$</td><td>-0.352</td><td>-13.0</td><td>-0.228</td><td>-4.8</td><td>-0.339</td><td>-5.9</td><td>-0.2985</td></tr>
<tr><td>Nesting coefficient (auto nest)</td><td></td><td>0.17</td><td>9.6</td><td>0.18</td><td>3.6</td><td>0.36</td><td>3.7</td><td>0.4</td></tr>
<tr><td>Modal constant Untolled Lanes</td><td>Util</td><td>0</td><td>fixed</td><td>0</td><td>fixed</td><td>0</td><td>fixed</td><td>0</td></tr>
<tr><td>Modal constant Toll Lanes</td><td>Util</td><td>-0.183</td><td>-7.2</td><td>-0.249</td><td>-2.9</td><td>-0.452</td><td>-3.7</td><td>-0.175</td></tr>
<tr><td>Modal constant AGS/Train</td><td>Util</td><td>-0.771</td><td>-9.0</td><td>-0.634</td><td>-2.6</td><td>-0.771</td><td>-2.5</td><td>-0.755</td></tr>
</table>

* Visitor model asserted
Source: SDG analysis

Discussion of the values of time

As will be noted, the utility specification includes travel cost interacted with traveler income; accordingly, determination of an implied value of time (VOT) requires reference to traveler income. Table 20 shows traveler VOTs assuming a $40K annual household (HH) income in each market segment, as calculated from the estimated mode choice models. Auto in-vehicle value of time variations for different household annual income are also presented in Table 21.

TABLE 20. VOT ASSUMING A $40K ANNUAL HH INCOME AND MODAL CONSTANTS

<table>
<tr><th rowspan="2" colspan="2"></th><th colspan="3">Corridor Residents</th><th rowspan="2">Visitors</th></tr>
<tr><th>Local Non-Work</th><th>Local Work</th><th>Local Airport Access</th></tr>
<tr><td>Auto VOT</td><td>$/hr</td><td rowspan="4">$8</td><td rowspan="2">$13</td><td rowspan="2">$19</td><td rowspan="2">$13</td></tr>
<tr><td>Toll VOT</td><td>$/hr</td></tr>
<tr><td>AGS/Train VOT</td><td>$/hr</td><td>$14</td><td rowspan="2">$21</td><td>$14</td></tr>
<tr><td>Out-of-Vehicle Time</td><td>$/hr</td><td>$16</td><td>$18</td></tr>
<tr><td>Modal constant toll</td><td>$</td><td>$2</td><td>$4</td><td>$5</td><td>$2</td></tr>
<tr><td>Modal constant AGS/Train</td><td>$</td><td>$8</td><td>$10</td><td>$8</td><td>$9</td></tr>
<tr><td>Modal constant toll</td><td>min</td><td>14</td><td>19</td><td>15</td><td>10</td></tr>
<tr><td>Modal constant AGS/Train</td><td>min</td><td>60</td><td>43</td><td>24</td><td>40</td></tr>
</table>

Note: all monetary values in $2012
Source: SDG analysis

TABLE 21. AUTO IN-VEHICLE VALUES OF TIME BY HOUSEHOLD ANNUAL INCOME

Household Income	Residents Non-Work	Residents Work	Residents Airport Access	Visitors
$125,000	$11	$16	$25	$17
$100,000	$10	$16	$24	$16
$75,000	$9	$15	$23	$15
$50,000	$9	$13	$21	$14
$40,000	$8	$13	$19	$13

Source: SDG analysis

Auto travelers generally have the lowest value of time. The visitor private vehicle VOT was asserted to be aligned with the local work VOT.

These values of time are slightly higher than the PEIS VOTs as reported in Table 22, but lower than the values recommended by the 2011 USDOT guidance[6]. Note that the PEIS VOTs were not mode-specific.

[6] "Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis", US Department of Transportation, Office of the Secretary of Transportation, September 28, 2011. The USDOT publishes guidance on travel time valuation in the economic analysis of transportation projects . The latest memorandum, dated November 2011, recommends an array of values of time for different categories of travel, according to income, purpose, mode and distance. For surface modes, the guidance recommends VOTs for non-work inter-urban travel in a range from 60% to 90% of personal hourly income (annual household income divided by 2080). The median hourly income for Denver MSA was $20/hr.

TABLE 22. SUMMARY OF PEIS VOTS

VOT ($/hr)	2000$	2012$
Local non-work corridor trips	$4.6	$5.9
Work trip or non-corridor leisure trips	$9.2	$11.9

Source: SDG analysis of PEIS mode choice model parameters

These values of time are aligned with SDG's previous high-speed rail projects and with other HSR studies conducted in the US.

Out-of-vehicle time (including both access and wait time) coefficients are also fully estimated for the resident travel markets. Out-of-vehicle time is found to be only 1.12 times more onerous than in-vehicle time for work trips; while for local non-work and airport trips, out-of vehicle time is not significantly different than in-vehicle time. For the visitor model, a higher ratio of 1.25 for both access and wait times is used to reflect the unfamiliarity with the access options in the regions. Note that ratios of out-of-vehicle to in-vehicle time are generally found to be much lower for inter-urban than for urban travel.[7]

Modal constants

Modal constants are terms included in modal utility functions to reflect the inherent attractiveness of a mode after its explicitly-modeled attributes have been accounted for. These constants represent the average contribution to a mode's utility of non-modeled attributes, and can be expressed as an equivalent modal travel time penalty or bonus. The untolled auto option is assigned a reference modal constant value of 0. A negative modal constant for a particular mode implies that, all else equal, travelers prefer the untolled auto option to it.

The AGS/Train and tolled option modal constant values shown in Table 23 for the resident markets are estimated using the 2012 SP survey and are aligned with results found in SDG's previous high-speed rail studies and other HSR studies conducted in the US. Consistent with the estimation of other variables in the mode choice models, the visitor model modal constant are asserted due to the lack of SP data for this segment. In Table 24, the modal constants have been converted into equivalent monetary or time penalties.

The tolled and untolled lane options are by nature more similar to each other, in terms of the effect of their unobserved attributes on demand, than they are to the AGS/Train. The SP survey analysis shows that the tolled lane option is perceived as slightly less attractive than the untolled option, for equal times and costs. For example, a toll option penalty of 14 minutes is estimated for resident non-work trips, assuming their other times and costs equal.

For these same trips, the AGS/Train penalty is estimated to be equivalent to a 60 min line-haul time compared to the reference untolled option, suggesting that auto attributes such as privacy

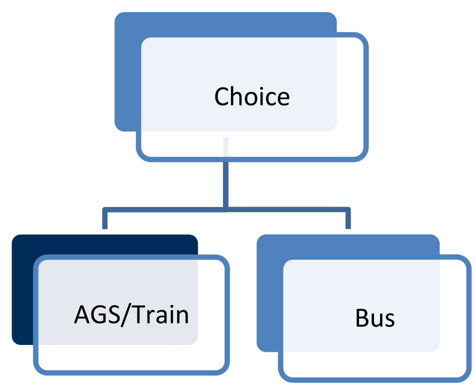
[7] Inter-urban travel waiting conditions are often much improved and the reliability of the scheduled service make the wait time less stressful while the access time is also a smaller portion of the overall journey for inter-urban travel compared to urban travel.

and flexibility are highly valued relative to unrepresented AGS/Train attributes. This is consistent with findings in SDG's previous studies and existing literature. For resident work trip, the AGS/Train mode penalty is equivalent to a 43 min line-haul time penalty. This finding is also supported by previous work and reflects the higher attractiveness of AGS/Train for business travelers than for leisure travelers (AGS/Train is a more productive mode).

The bus diversion model

The inter-urban bus demand forecasting approach is similar to the inter-urban auto demand forecasting approach described above. Market-specific mode choice models are applied to predict, for 2035 and for each OD pair, the number of bus travelers who will be using the AGS/Train mode. The bus inter-urban mode choice models use a binary diversion form and compute the probability that an OD specific inter-urban bus traveler making a particular trip type will choose the AGS/Train mode given the LOS characteristics for each modes. Figure 21 shows the binary diversion model structure used to predict the number of AGS/Train trips that will divert from the existing bus mode; it shows bus as the existing mode and AGS/Train as the new mode.

FIGURE 21. BINARY DIVERSION MODEL STRUCTURE USED FOR INTER-URBAN BUS MODEL



The general specification of the utility for each mode i is as follows:

$$V_i = \alpha + \beta_{cost} * Cost + \beta_{ivt} * IVT + \beta_{acc} * AccessTime + \beta_{wait} * WaitTime$$

With α the modal constant (the bus constant was assigned a reference value of 0),

β's the model coefficients,

$Cost$ the cost of taking the bus or the AGS/Train (including fare, parking and any access costs), IVT the in-vehicle time, $AccessTime$ the time to access *and* egress the station including terminal wait times, and $WaitTime$ the wait time defined as ¼ of the headway.

In the case of a binary logit model, the probability (or mode share) of choosing the AGS/Train mode can be expressed as follows:

$$Share_{AGS/Train} = \frac{e^{V_{AGS/Train}}}{e^{V_{bus}} + e^{V_{AGS/Train}}}$$

Model coefficients and modal constants

Modal coefficients and modal constants are determined using professional judgment acquired from SDG's previous U.S. high speed rail studies. Bus mode choice models are asserted for two market segments:

- Work
- Non-work

Table 23 shows the model coefficients and modal constants used in the bus diversion model.

TABLE 23. INTER-URBAN BUS MODEL: MODEL COEFFICIENTS AND CONSTANT

Binary Diversion Models	***Unit***	**Non-Work**	**Work**
In-vehicle Time	util/min	-0.00200	-0.00500
Access Time	util/min	-0.00300	-0.00800
Wait Time	util/min	-0.00400	-0.01000
Cost	util/$ in 2012$	-0.03314	-0.03977
AGS/Train modal constant	util	0.00700	0.01300

Source: SDG professional judgment and previous U.S. high speed rail studies

AGS/Train modal constants shown in Table 24 expressed in minutes are equal to the time advantage of the AGS/Train mode over the bus option, keeping all times and costs equal for the competing modes. An AGS/Train modal constant equivalent to a 3.5 min advantage is used for non-work trips and 2.6 min for work trip.

Table 24 also shows the corresponding values of time (VOT) of travelers. Values of $3.6/hr and $7.5/hr are used for non-work and work trips, respectively for inter-urban bus travelers. Note that bus VOTs are generally much lower than auto VOTs. Bus wait and access times are typically weighted more than in-vehicle time. A factor of 1.5 and 2.0 were used for access and wait times, respectively.

TABLE 24. BUS VOT AND MODAL CONSTANTS (IN EQUIVALENT MINUTES)

Value of time ($/hr) and AGS/Train bonus	Non work	Work
In-vehicle Time	$ 3.6	$ 7.5
Access Time	$ 5.4	$ 12.1
Wait Time	$ 7.2	$ 15.1
Modal Constants	3.5 min	2.6 min

Source: SDG analysis

The diversion model is applied to predict the share of inter-urban bus travelers who will switch to the AGS/Train mode, considering their respective LOS characteristics.

Induced Demand Model

The introduction of a new transportation facility typically results in new trips being made, trips that were not made before. These are termed induced trips.

The final step in the inter-urban AGS/Train ridership forecasting process is to forecast the volume of induced travel brought about by the AGS/Train mode. Induced demand is estimated using a travel utility function based on the mode choice model.

Induced demand is calculated based on the impact the introduction of the AGS/Train mode has on the transportation system as a whole. For each inter-urban zone pair, the total generalized cost (including all travel modes) is calculated before and after the introduction of the AGS/Train mode. Differences in generalized costs pre- and post-AGS/Train are used to calculate the percent increase in total travel for each inter-urban OD pair as illustrated below;

New travel induced by the AGS/Train mode is:

$$Induced\ travel = T_{with\ AGS/Train} - T_{without\ AGS/Train}$$

where $T_{with\ AGS/Train}$ is the total travel with the AGS/Train service in place, and correspondingly for $T_{without\ AGS/Train}$.

The volume of induced travel depends on the accessibility changes made possible by the new AGS/Train service. Total travel on all modes is related to a composite generalized cost, as follows:

$$T_{OD} = SE_{OD}^{\alpha} * GC_{OD}^{q}$$

where T_{OD} is the total travel volume between a particular origin and destination on all modes;

SE_{OD} are socio-economic characteristics of the origin and destination;

GC is the generalized cost of travel between the origin and destination; and

α and q are model coefficients or elasticity values.

The composite generalized cost used in this model is known as the logsum and is calculated using the utility estimates for each mode from the mode choice model. For a MNL model, the logsum is simply $GC = ln(e^{U_{free\ lane}} + e^{U_{tolled\ lane}} + e^{U_{AGS/Train}})$.

Consequently, it can be written:

$$T_{without\ AGS/Train} = SE^{\alpha} * GC_{without\ AGS/Train}{}^{q}$$

$$T_{with\ AGS/Train} = SE^{\alpha} * GC_{with\ AGS/Train}{}^{q}$$

When applied to a given year, the socio-economic variables without and with the AGS/Train are the same and cancel each other so that the percent increase in total travel becomes:

$$Induced\ demand\ \% = \frac{T_{with\ AGS/Train} - T_{without\ AGS/Train}}{T_{without\ AGS/Train}}$$
$$= \frac{GC^{q}_{with\ AGS/Train} - GC^{q}_{without\ AGS/Train}}{GC^{q}_{without\ AGS/Train}}$$

This calculation is done for each travel purpose and for each OD pair. Application of the induced demand model for each OD pair and market segment for the inter-urban travel market produces the induced travel estimates. Total AGS/Train trips for the inter-urban market are then the sum of the AGS/Train trips forecast by the mode choice model and the new trips induced by the AGS/Train project.

In model applications, it was verified that the predicted induced demand percentages are reasonable. Values in the range of 8%-10% were typically found and are comparable to values found in other new high-speed rail studies in the US.

In the SP survey, respondents were asked if they would travel more often if an AGS/Train service was available, and if so, how much more. It is therefore possible to estimate qualitatively the stated value of the induced demand based on survey data. 21% of the respondents said that if an AGS/Train service like the one described in the survey was available, they would make more trips along the corridor than they currently do. Respondents who replied they would travel more often were also asked how many more trips they would make. Based on the amount of additional travel reported by these respondents, it can be estimated that total travel would increase by about 8% overall in the corridors. This result is consistent with the induced demand percentage obtained from the generalized cost based calculation (as shown above) that is used for each OD pair in this study.

Section 3: New Original Data Collection

Data Collection for the Inter-Urban Auto Trip Table Development

In forecasting inter-urban passenger rail ridership and revenue, the accuracy of the auto trip tables strongly influences the overall accuracy of the forecasts. However, in the US relatively little data on inter-urban automobile travel is collected at the national level, and there currently is no standard up-to-date source of information about inter-urban auto trip making that is sufficiently detailed to be used in project-level forecasting.

Furthermore, in the ICS/AGS study area itself there is no single source of information on inter-urban auto travel. The estimates of inter-urban travel volumes used in the I-70 PEIS and the North I-25 EIS are possible sources of such data. However, the trip tables used in these studies were not based on original OD surveys. Moreover, the inter-urban trip tables from the I-70 PEIS are now over a decade old, certainly requiring an update and making their use for the ICS subject to question and possibly criticism.

Study area MPOs have recently participated in the Front Range Travel Survey (FRTS), which covered both local travel in the participating MPOs as well as some longer distance travel. Issues related to the appropriate weighting of the longer-distance FRTS results were being worked out and the data was not ready in time to be used for this study.

All of the four corridor MPO travel models incorporate a representation of internal/external and external/internal auto trips (those that enter/exit the model area from/to elsewhere), but do not provide detailed identification of the external origins and destinations. Data in the individual models is not specific enough by itself to allow the individual model trip tables to be "woven" together into a single trip table covering the entire corridor and providing information on, for example, the number of auto trips from a particular zone in Denver to a particular zone in Colorado Springs.

The 1995 American Travel Survey (ATS), which focused on long distance tripmaking by households, was considered as a possible source of data, but is not used for several reasons. The information is starting to be quite dated. Moreover, the low sample size used in this survey (80,000 households across the U.S.) seriously constrains its accuracy at a detailed geographic level such as a corridor.

Information on journey-to-work travel in the corridor can be obtained from the year 2000 Census Transportation Planning Package (CTPP)[8]. In particular, within the limits of the Census long form sample rate (roughly 15% of households), the CTPP gives detailed information on work commute volumes and patterns by mode, including auto. Although the information dates from year 2000, with suitable factoring it is an adequate basis for establishing current inter-

[8] The Census long form questionnaire from which the CTPP data is extracted was discontinued following the 2000 Census.

urban commute travel volumes and patterns, as well as for checking the estimates made for other modes and using other data sources.

On the other hand, a significant portion of inter-urban travel in the corridor is auto trips for purposes other than the journey to work (e.g. leisure trips to the mountain areas by study area and by non-residents). As discussed above, investigations did not reveal any readily useable source of data on these trips.

Of course, traffic volume and classification counts are available for the major corridor roadways. The problem is that the traffic data combines both travel within the corridor and longer-distance travel, as well as travel for different purposes, without distinction or identification of origin and destination.

The lack of detailed up-to-date data on inter-urban automobile travel in the study corridor prompted the investigation of a new program of original travel data collection. Among possible data collection efforts, conducting new surveys to establish intercity automobile travel patterns and levels is quite resource intensive. Moreover, there are other issues that may limit the usefulness of new surveys. On the one hand, intercept surveys conducted directly on major roadways such as I-70 or I-25 would likely encounter logistical difficulties and other obstacles, while surveys of drivers at off-mainline locations such as rest stops tend to give highly biased results. On the other hand, interview or travel diary surveys of randomly selected households in the corridor would duplicate work done by the FRTS, and collecting information on inter-urban travel in this way can sometimes be challenging because of the relative infrequency of these longer-distance trips.

Use of anonymous cell phone data was determined to be the most cost-effective way to understand the origins and destinations of auto travelers in the corridor. A firm called AirSage was engaged for this purpose. AirSage has a contract with Sprint to obtain the communications protocol data exchanged between mobile devices and communications towers; this data allows the movements of mobile devices to be analyzed in a way that preserves the anonymity of device owners and the privacy of their communications. Archived data is available from January 2010.

Trip Table Data

The AirSage data is based on raw cell phone data that is processed to link cell phone signals to form distinct trips classified by type (i.e. Resident, Non-resident, and Through). These trips are then geocoded and aggregated to a zone system (effectively anonymizing the data) and expanded from the sample of cell phone users to the population as a whole based on census block population and carrier sampling rates.

It is necessary to identify representative time periods for which cell phone data is obtained and processed. Based on an examination of CDOT data on the monthly distribution of traffic volumes at rural locations on I-70 and I-25, it is decided to prepare intercity auto trip tables for three month-long periods in 2011. The selected months are mid-February to mid-March, and all of

July and October. The first represents a peak winter recreational period; July generally has the highest traffic volumes on both facilities and captures summer recreational travel; while October is a "typical" month in terms of volumes and likely mix of trip purposes.

Based on cell phone location data from Sprint, AirSage provided auto trip data for 40,000 origin-destination (OD) combinations (200x200 zone pairs[9]) in the study area. The trip tables were segmented by:

- 3 monthly periods in 2011 (as described above)
  - February
  - July
  - October
- 4 day types
  - Mondays-Thursdays
  - Fridays
  - Saturdays
  - Sundays
- 3 traveler classifications
  - Resident – frequent signal occurrence in the study area over the sampling period
  - Visitor – limited signal occurrence in the study area over the given period
  - Through – trip origin and destination beyond the study area

Trip Table Processing

The inter-urban model produces annual ridership and revenue forecasts and, accordingly, the input trip tables are converted from daily trip tables to annual trip tables. Seasonality factors determined from CDOT monthly traffic count data (shown in Table 25) are used to convert the daily trip tables provided for each of the three months into three annual trip tables. A factor less than 1 implies that trip volumes in that month are higher than throughout the rest of the year, as is seen in February and July. The three resulting trip tables are then averaged together to get an average annual trip table.

TABLE 25. TRIP TABLE SEASONALITY INDICES

Month	Index
February	0.99
July	0.84
October	1.06

Additionally, the study area is comprised of more zones than were processed by AirSage so the OD trips were disaggregated from 200x200 to 3142x3142 zone pairs based on population. For

[9] The original 3,241 zones were aggregated by the study team to develop 200 zones that were used by AirSage to base their initial raw trip table. This was later further disaggregated to develop auto trip tables for the original 3,241x3,241 zone system.

example, if an AirSage zone contains 5 subzones, then each of the 5 subzones receives a share of the trips based on its share of population relative to the total AirSage zone population.

During the trip table calibration and validation process (see section below), some further adjustments are made to the trip table. It is determined that the AirSage trip table seemed too high for a few markets, so the following factors were applied to these markets in order to adjust the volume of trips:

- If an OD auto trip travels on I-70 for less than 85 miles (e.g. short distance I-70 trips), a factor of 0.5 was applied
- If an OD auto trip travels on I-25 for more than 50 miles (e.g. long distance I-25 trips), a factor of 0.6 was applied

Trip Table Validation

In order to validate the AirSage trip table, TransCAD's select link analysis is used to assign OD AirSage trips to the study area highway network and determine the volume of trips crossing 6 designated links. These 6 locations (3 along I-25 and 3 along I-70, as shown in Figure 22) correspond to rural CDOT traffic count locations. By dividing the AirSage trips by an average auto occupancy, thereby converting person trips to vehicle trips, a direct comparison is made with CDOT AADT counts. Average vehicle occupancy rates are estimated from the Front Range Travel Survey to be 1.93 and 2.42 persons/vehicle for the I-25 and I-70 corridors, respectively. As seen in Table 26, the assigned AirSage vehicle trips are within 7% of CDOT AADTs at all traffic locations considered.

FIGURE 22. TRAFFIC COUNT VALIDATION LOCATIONS

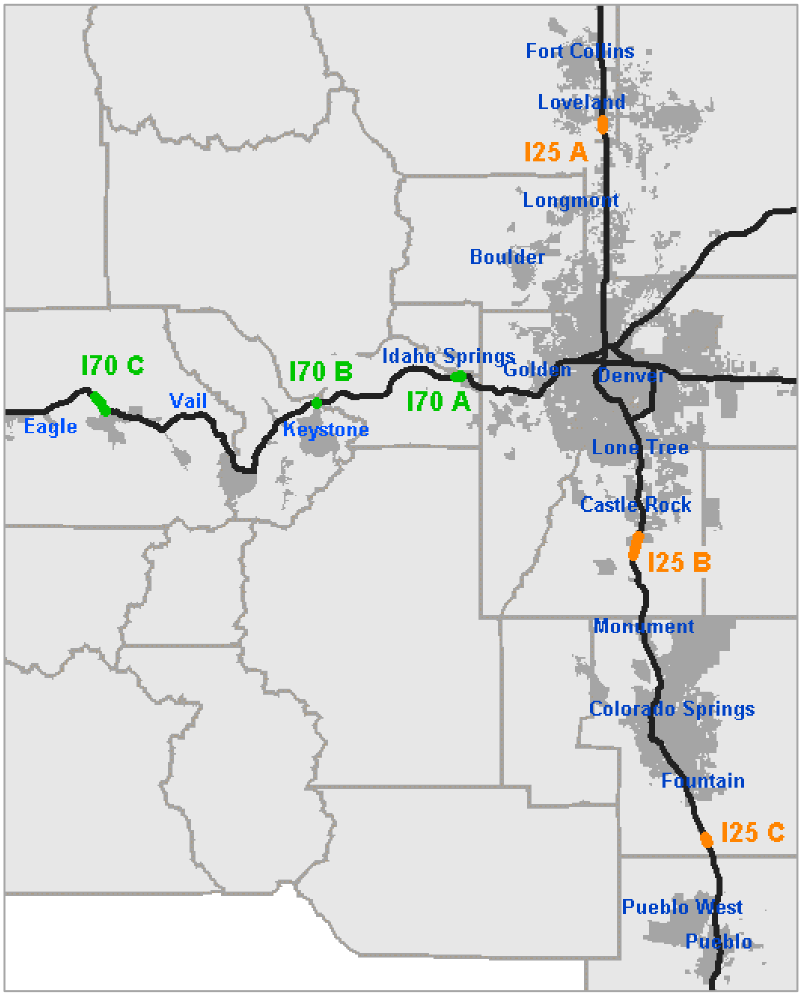


TABLE 26. TRAFFIC COUNT VALIDATION

Count Location	CDOT AADT	AirSage AADT	Percent Diff.
I70 A	43,000	45,048	4.8%
I70 B	29,000	30,952	6.7%
I70 C	22,000	20,519	-6.7%
I25 A	68,000	63,688	-6.3%
I25 B	60,000	61,299	2.2%
I25 C	31,000	31,722	2.3%

Trip Table Segmentation

Once validation of the AirSage trip table was complete, certain trips are removed to prepare the trip table for the inter-urban mode choice model. The OD trips that are removed include:

- auto trips within the DRCOG boundaries (Denver area), as these are captured in the intra-urban modeling effort
- auto trips with an auto in-vehicle distance less than 50 miles, as these are too short to be diverted to an inter-urban rail mode
- truck trips (9% of AirSage OD trips), as determined from CDOT traffic count data
- inter-urban bus trips, as estimated based on supply side information and load factor assumptions

Additionally, the inter-urban mode choice model is developed for four distinct markets/ purposes, and the auto trip table is segmented accordingly. Figure 23 illustrates how AirSage trip classifications are mapped into SDG's trip classifications. The AirSage *Through* market is not divertible to inter-urban rail and is thus disregarded, while AirSage's *Non-resident* market is re-classified as the *Visitor* market. AirSage *Resident* trips with an origin or destination at Denver International Airport are re-classified as *Airport Access* trips. The *Resident* trips without an airport end are then split into *Work* and *Non-work* purposes, based on a share estimated from the SP Survey (11%). To represent the decreasing likelihood of making a work trip with increasing distance, shares are allocated based on OD auto distance accordingly:

- 50-75 miles: 13% work / 87% non-work
- 75-100 miles: 10% work / 90% non-work
- >=100 miles: 7% work / 93% non-work

FIGURE 23. AUTO TRIP TABLE MARKET SEGMENTATION

Stated Preference Survey Data Collection

Developing a thorough understanding of travelers' behavior is a critical element of demand forecasting for new inter-urban modes such as the proposed future AGS/Train system. In order to assess the attractiveness of the AGS/Train mode relative to other existing inter-urban modes, data is required about traveler responses to the new mode. These data is obtained from surveys called Stated Preference (SP) surveys. SP surveys are used to elicit traveler preferences and tradeoffs involving different modal attributes. Survey data can then be used to develop choice models involving the new mode, such as the nested logit models developed as part of this study described in Section 2: Technical Documentation of Ridership and Revenue Modeling for the Inter-Urban Travel Market. Both the I-70 PEIS and the RMRA studies undertook SP surveys.

It was not possible to locate detailed survey data from the RMRA. The consensus among Denver-area transportation planners about this is that the data is simply not available.

In contrast, SP survey data is available from the I-70 PEIS. The data was obtained its potential applicability to the ICS study and assessed. It was concluded that this dataset is not usable for this current study, as the investigation of this dataset revealed a number of potentially serious issues:

- the PEIS had difficulty using this data to develop its models. Standard statistical analyses produced unreasonable values for many key parameters, so the PEIS model development team was forced to constrain (fix) their values – a procedure that is generally considered less than desirable;
- the number of new modes considered in the PEIS and its SP survey was very large10 – shuttle van, tour bus, guideway bus, train or monorail – and in some cases the presentation of these modes to survey respondents may have been unclear. SP survey respondents tend to become confused or fatigued when presented with large numbers of very different choices, and this can ultimately lead to the survey producing poor quality data;
- the number of modal attributes incorporated in the survey was also very large and may have overwhelmed the respondents, again possibly compromising the quality of the survey results; and
- travelers' behavior may have fundamentally changed in the last decade.

Ideally, forecasting efforts should be based to the extent feasible on recent locally-collected data. The advantages of this are that it provides the best possible empirical basis for accurate forecasts, it allows incorporation of conclusions and results from earlier efforts, and it guards against possible criticisms regarding lack of local relevance in mode choice modeling. Travelers' behavior with regards to willingness to pay for travel time savings is key to determine how much of the demand will choose to use the AGS/Train at different fares. Values of time in terms of time savings as they are perceived by users of the AGS/Train service may differ from the actual travel time savings they offer, and thus it is also important to understand corridor-specific traveler's preferences and local attitude toward travel, the project and common carrier modes. Other useful characteristics of study area travel such as auto captivity, travel party size, travel purpose, etc. can also be obtained via a survey. Hence, it was decided to undertake a new but limited SP survey for this study and to develop new mode choice models (as described in Section 2: Technical Documentation of Ridership and Revenue Modeling for the Inter-Urban Travel Market) based on this data.

An internet-based SP survey was developed and conducted. Due to time constraints, the survey focused on study area residents who were members of a market research survey panel; it was not possible within these constraints to survey visitors from outside the study area.

This new Stated Preference survey presented hypothetical but realistically representative travel options, including the proposed new AGS/Train, to survey respondents and asks them to indicate which option they prefer. The survey also collected more general attitudinal data to better understand travel behavior in the corridor. The survey asked respondents about their current travel behaviors. It presented them with information about the proposed corridors and used Stated Preference experiments to estimate travelers' propensity to use the proposed AGS/Train corridor as well as a possible toll corridor under a range of different travel times and costs.

SP Survey Context

The Stated Preference survey was focused on corridor residents having made an automobile trip within the corridor (see Figure 24). The primary objective of the Stated Preference survey is to estimate statistical models to understand the sensitivities to in-vehicle and out-of-vehicle travel time and cost to calculate the willingness to pay for travel time savings and estimate inherent preferences of corridor travelers.

FIGURE 24. SP SURVEY CORRIDOR MAP

The survey approach employed a computer-assisted self-interview (CASI) technique. The Stated Preference survey instrument was customized for each respondent by presenting questions and modifying wording based on respondents' previous answers. These dynamic survey features provide an accurate and efficient means of data collection and allow presentation of realistic future conditions that correspond with the respondents' reported experiences. The customized software was programmed for online administration to a targeted sample of residents and travelers within the proposed corridor.

Data collection took place in December of 2012 throughout the proposed corridors. The passenger vehicle survey was administered over the Internet to residents living within or near the proposed corridor. A total of 982 passenger vehicle travelers provided valid responses over a two-week period. Respondents were recruited using a sample from Research Now described in detail below.

SP Survey Administration

Survey respondents were recruited using a paid sample provider, Research Now. The survey link was sent to Research Now sample who are at least 18 years old and reside within specific counties lying along the I-25 and I-70 corridors, listed in Table 27 below.

TABLE 27. COUNTIES ALONG STUDY CORRIDOR

Counties Along Study Corridor			
Adams County	Douglas County	Huerfano County	Pitkin County
Arapahoe County	Eagle County	Jackson County	Pueblo County
Boulder County	El Paso County	Jefferson County	Summit County
Broomfield County	Elbert County	Lake County	Teller County
Clear Creek County	Fremont County	Larimer County	Weld County
Crowley County	Garfield County	Lincoln County	
Custer County	Gilpin County	Otero County	
Denver County	Grand County	Park County	

Once these potential respondents were screened, they were sent the survey link, and the questionnaire gave them additional screener questions. Respondents were eligible to complete the full survey if they were a driver or passenger for a trip where:

- The trip used the study corridors (shown highlighted on a map)
- The trip was made in a personal vehicle or rental car
- The trip was made within the last 6 months
- The trip took at least 45 minutes in door-to-door travel time for one way

If they did not meet the above criteria, the respondent was still eligible if they were a Denver area resident who made a trip to the Denver airport in the last 6 months. The ZIP codes used to determine Denver area residency are shown in Table 28.

TABLE 28. DENVER AREA ZIP CODES

Denver Area ZIP Codes									
80002	80205	80212	80220	80227	80234	80244	80256	80264	80290
80022	80206	80214	80221	80228	80235	80246	80257	80265	80291
80033	80207	80215	80222	80229	80236	80247	80259	80266	80293
80201	80208	80216	80223	80230	80237	80248	80260	80271	80294
80202	80209	80217	80224	80231	80238	80250	80261	80273	80295
80203	80210	80218	80225	80232	80241	80251	80262	80274	80299
80204	80211	80219	80226	80233	80243	80252	80263	80281	80401

SP Survey Experiment

To collect data about the mode choice behavior of corridor travelers, respondents were confronted with survey questions that required them to choose between three travel options characterized by different attributes of time, cost and mode. Each respondent took part in 6 SP choice experiments. To preserve realism, the hypothetical options presented in these experiments were constructed from the characteristics of an inter-urban trip that the respondent had actually made (a reference trip).

This survey technique is commonly used in transportation studies to infer how travelers' preferences for existing and hypothetical modes and services are affected by the features or attributes of those modes (such as travel time and travel cost). Through statistical analysis of the results of choice experiments, it is often possible to estimate mode choice models that predict, for each available mode, the probability that an individual will choose it for a trip, as a function of the characteristics of the individual, the trip and the available modes. Mode shares can then be obtained by aggregating individual choice probabilities to the population of travelers.

After collecting background information about their reference trip, respondents moved on to answer a series of Stated Preference questions. Before the Stated Preference questions were administered, respondents were provided with details about the AGS/Train and possible tolls on the corridors. The project information survey page is shown in Figure 25.

Figure 25. Project information survey page

Project Information

In order to provide faster and more reliable travel between the cities and towns on the I-25 and I-70 corridors, the Colorado Department of Transportation is considering various transportation options.

One option is the development of a new high-speed transit system also called an **Advanced Guideway System** along or near the I-70 and I-25 corridors; this system will be referred to here as **the AGS/Train**. The AGS/Train will operate along a fixed guideway that is separated from road traffic and will not be impacted by traffic conditions. Different AGS/Train operating speeds are under consideration. The blue lines on the map show possible AGS/Train routes.

Tolls already exist on some highways (i.e. I-25 carpool/toll lanes, E-470 tollway) and may be considered for any new lanes that would be added to the state/interstate highway system. Transit and highway investments may both occur in some corridors like I-25 and I-70. To be successful, they must operate well together if both exist in the same corridor.

Please click "Next Question" to continue.

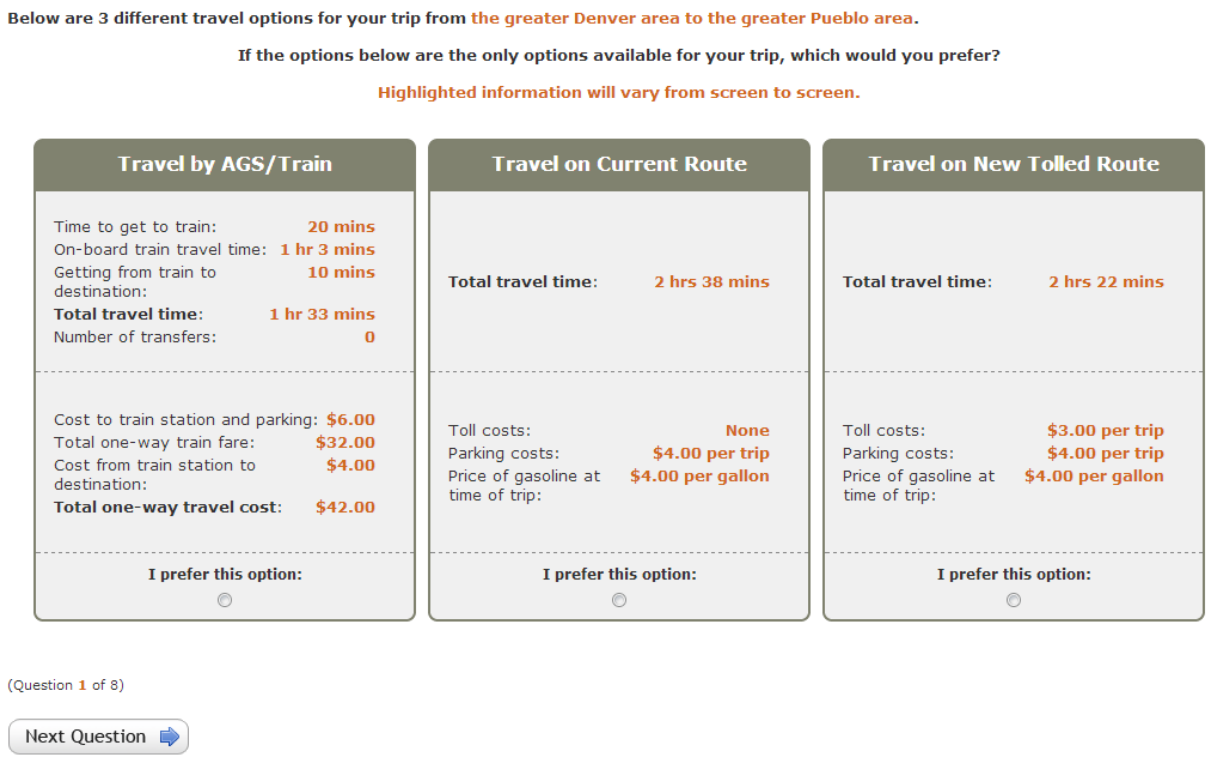
Next Question

The Stated Preference questions were quantitative experiments designed to estimate respondents' travel preferences and behavioral responses under hypothetical future conditions. The details of each respondent's reference trip, including travel time and trip distance, were used to build a set of eight Stated Preference scenarios that presented respondents with three alternatives for making their trip in the future:

- Make their trip using their current route
- Make their trip using an automobile on a newly tolled road
- Make their trip using the proposed AGS/Train service

Each alternative was described by attributes that belong to two categories: travel time and cost. Additionally, the AGS/Train option had a variable for the number of transfers. The values of the attributes varied independently across the eight choice experiments, and respondents were asked to select the alternative they preferred the most under the conditions that were presented. Figure 26 shows an example of a Stated Preference scenario. In order to avoid potential bias associated with the layout of the alternatives, the order of these alternatives was randomized for each respondent.

FIGURE 26. EXAMPLE OF A STATED PREFERENCE SCENARIO



SP Survey Analysis

The mode choice models used to forecast ridership use statistical relationships that predict the fraction of travelers who will divert from the existing mode to the AGS/Train mode as a function of the respective modal service attributes. These relationships have been developed using the locally-collected SP survey data, and the coefficient values of our mode choice models are then estimated using the locally collected data. The survey data is also used to obtain important modeling inputs and statistics, such as trip purpose, trip duration and travel party size.

Survey respondent reference trip profile

To preserve realism, the hypothetical options presented in the Stated Preference survey experiments were constructed from the characteristics of an inter-urban trip that the respondent had actually made (the reference trip). The revealed preference survey data consists of the observed travel characteristic of this reference trip; including trip purpose and trip length. 78% of the survey responses were for leisure trips with on average 2.4 passengers per vehicle, as shown in Table 29.

TABLE 29. SP SURVEY PURPOSE AND VEHICLE OCCUPANCY

Purpose	Share	Vehicle occupancy
Non-work	78%	2.4
Work	10%	1.7
Airport access	12%	2.0
ALL	100%	2.2

Average trip lengths by trip purpose are reported in Table 30. As expected, non-work trips tended to be the longest, with a mean trip duration of 102 min, followed by work trips (mean 86 min) and airport access trips (75 min). Overall, the median trip duration was 90 min.

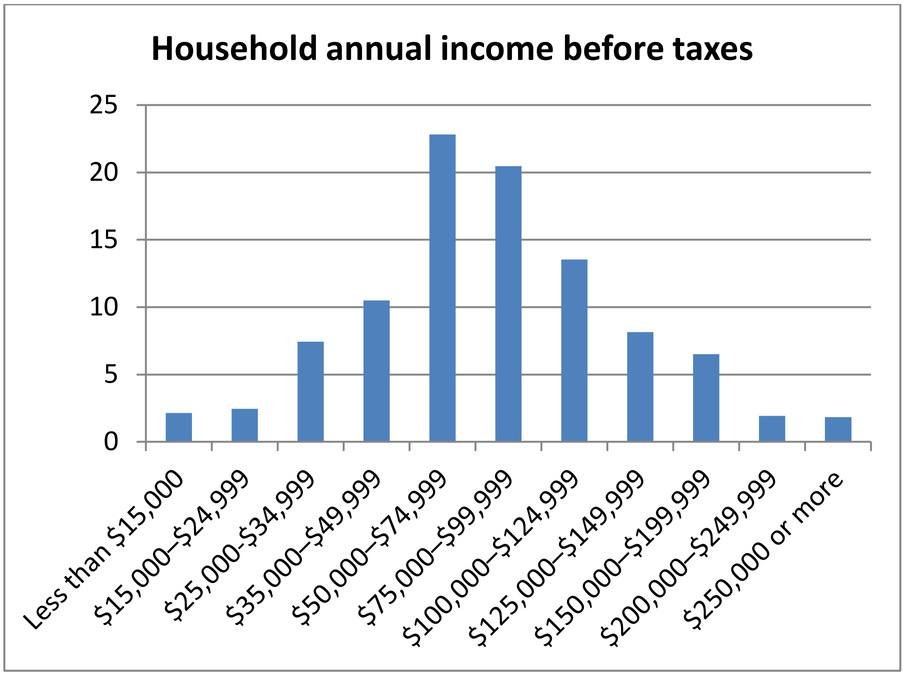
TABLE 30. SP SURVEY REFERENCE TRIP LENGTH BY TRIP PURPOSES

Travel time in minutes	Mean	25th Percentile	Median	75th Percentile	95th Percentile	Maximum	Minimum
Non-work	102	65	90	120	190	300	45
Work	86	60	70	105	165	270	45
Airport Access	75	50	68	90	125	300	22
All	97	60	90	120	180	300	22

Survey respondents were asked about their travel experience during their reference trip. 40% of the survey respondents reported experiencing travel delay, with a typical delay of 15 to 20min. 23% of the respondents reported the need to make stop along the way (other than for gas). They are referred to as en-route captive. 31% reported needing their car at their destination.

The distribution of annual household income of survey respondents shown in Figure 27 is aligned with the income distribution of the overall population of corridor residents, with a median lying between $50,000 and $75,000.

FIGURE 27. HOUSEHOLD ANNUAL INCOME BEFORE TAXES



Opinion of SP respondents on new transportation options

Respondents were asked their opinion on the new transportation options. Figure 28 and Figure 29 show the opinion of SP respondents on the new transportation options. More than 60% of the survey respondents were in favor of the AGS/Train, while more than half of the respondents reported being opposed to adding tolls on I-25 or I-70.

FIGURE 28. OPINION OF A NEW AGS/TRAIN

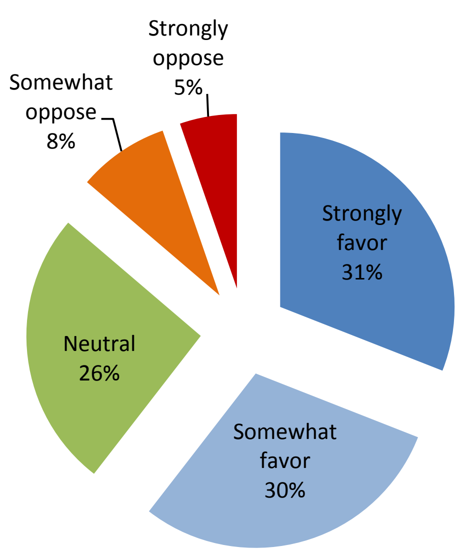
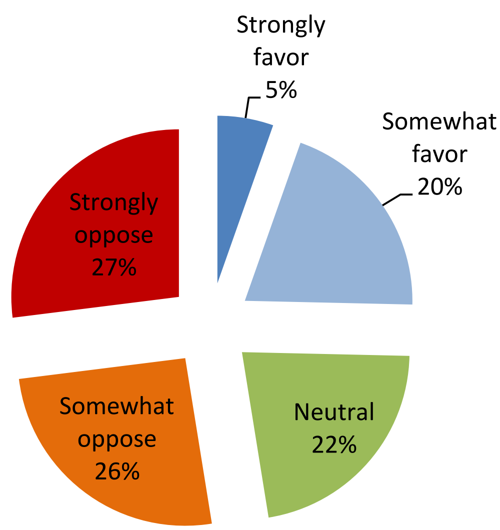


FIGURE 29. OPINION OF ADDING TOLLS ON I-25 AND I-70



Respondents were also asked the primary reasons they selected the AGS/Train option during the SP experiment, if they did. The primary reasons they selected it were:

- Time savings (30%)
- I support the construction of an AGS/Train system (12%)
- An AGS/Train is more environmentally friendly than driving (12%)
- I don't like to drive in congested traffic (11%)

The primary reasons the AGS/Train option was not selected during the SP experiments were:

- The cost is too high (60%)
- I need a car at destination (15%)
- It is too difficult to get from the AGS/Train to my destination (4%)
- I don't want to ride the AGS/Train (4%)

Stated preference data use

The SP survey data is used to statistically estimate the inter-city mode choice model parameters. Mode choice model coefficients for the three resident markets are developed directly from the data, while the visitor model is asserted as no corridor visitor SP survey was available. 24% of respondents were non-traders who always picked their current travel option as their preferred mode.

The detailed results of the SP analysis and the mode choice models estimated are explained in detail earlier in Section 3: New Original Data Collection.

Section 4: Ridership and Revenue Modeling for the Intra-Urban Travel Market

Methodology

All the AGS/Train alternatives considered for this study include several stations inside the Denver Metropolitan area including the Denver International Airport (DIA), Denver Union Station, Lone Tree, North Suburban and others. As such, the AGS/Train mode provides local rail service via these stations and thus serves as an urban travel option analogous to bus, light rail, and commuter rail. The interaction of the AGS/Train with the local transit system in Denver metro area is therefore an important element of demand modeling in an urban context. Accordingly, this study investigates interactions between the AGS/Train project and the Denver metropolitan transportation system both as regards the metropolitan access/egress portion of inter-urban AGS/Train trips, as well as the functioning of the AGS/Train project as a local travel mode within the Denver area.

The DRCOG Compass model has been developed to predict travel flows and conditions in the Denver metro area.[10] The model uses multinomial logit mode choice models that predict travelers' choices between several auto mode options as well as a variety of transit modes with their access/egress components. Existing and possible future RTD modes are represented within the transit modes of the Compass model. In effect, for any particular OD trip, the Compass model assesses the mode choices by comparing the time, cost and other modal service attributes of each available mode; the comparison also includes a term (mode specific constant) that reflects travelers' intrinsic preferences for each mode, other things equal. In addition, alternative specific dummy variables are used in the model to account for four geographic market segments – trips attracted to Boulder; trips attracted to the Denver CBD; trips attracted to DIA; and all other trips. The mode choice model parameters including the mode specific constants and the geographic market specific dummies were adjusted during the model calibration process to obtain a statistically satisfactory match between model results and observed market shares.

The intra-urban model for this study is adapted from the latest TransCAD four-step travel demand model (COMPASS 4.0) developed and maintained by Denver Regional Council of Governments (DRCOG). As part of the adaptation, the AGS/Train mode is added as an additional transit mode within the already-defined mix of transit modes in the COMPASS model and with proper adjustments as required. This approach makes maximum use of the detailed understanding of Denver-area travel patterns and behavior already embodied in the Compass

[10] DRCOG has recently also developed a next-generation forecasting model called Focus. As Focus has not yet been applied for production use outside of DRCOG, the ICS forecasting effort preferred to rely on the better-established Compass model and avoid the risks inherent in early applications of a new model system.

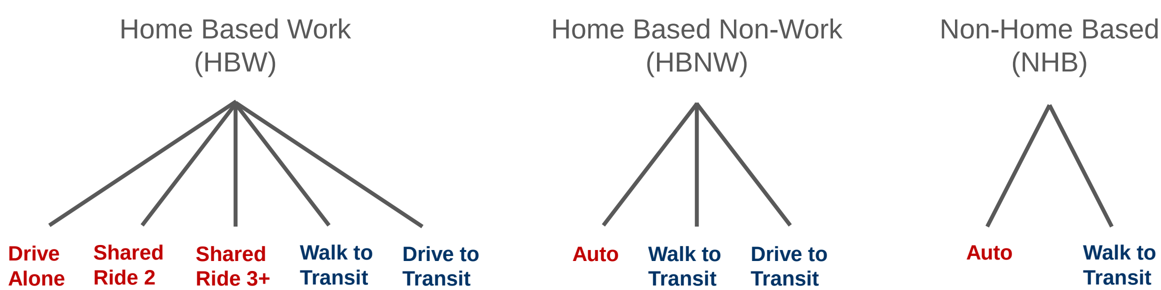
model system as well as periodic updates and validation undertaken since the model's inception.

DRCOG COMPASS Model

The key components of the four-step DRCOG COMPASS model are trip generation, trip distribution, mode choice, and trip assignment. For this study, the zonal characteristics that drive the trip generation and distribution steps remain unchanged across all scenarios. The mode choice and trip assignment outputs, on the other hand, vary based on the high-speed rail characteristics in a given scenario. Because of their relevance to the application of the DRCOG model for this analysis, the mode choice and assignment steps are summarized below.

The DRCOG mode choice model probabilistically predicts the mode of travel for OD trips based on relative times and costs of auto and transit options. Mode shares are determined by multinomial logit models developed for three trip purposes: Home Based Work (HBW), Home Based Non-Work (HBNW) and Non-Home Based (NHB). These models are applied separately by income group (for HBW only) and geographic market (Boulder, Denver CBD, DIA, and Other). Figure 30 below shows the nesting structure of the three models, with auto and transit modes differentiated by vehicle occupancy and access mode, respectively.

FIGURE 30. DRCOG MODE CHOICE MODELS



The model's transit and highway skimming step determines the shortest path via highway or transit between each OD zone pair. The procedure calculates the minimum time/cost to traverse those paths, which are used in the mode choice step to calculate mode shares and subsequently in the assignment step to calculate highway volumes and transit route ridership.

The DRCOG model uses one of TransCAD's built-in transit skimming/assignment methods known as Pathfinder. Pathfinder is a hyperpath-based approach, allowing multiple transit routes to be included in an OD path choice set. Paths are skimmed to determine their generalized cost based on expected values of access, wait, in-vehicle, and transfer times plus fares and penalties. OD demand is assigned to the hyperpath with the minimum generalized cost. Within a hyperpath, demand is split between parallel routes (or portions of routes) based on service frequency.

DRCOG COMPASS Model Adaptation

An important goal in incorporating the AGS/Train mode within the DRCOG model is to make minimal changes in order to avoid compromising the model's calibration. Consequently, AGS/Train is introduced into the model within the existing rail mode alongside the light rail and commuter rail routes planned by Denver's transit operator, the Regional Transportation District (RTD). The alternative—developing a new "transit-plus" mode, along with new model coefficients, within the existing DRCOG mode choice model—is deemed too time intensive and uncertain considering the model was calibrated for its existing structure and coefficients.

Because AGS/Train is treated as a rail mode, the existing DRCOG rail parameters and coefficients are applied during skimming, mode choice, and assignment. AGS/Train is set apart from other routes within the rail mode, through travel time, frequency, and fare. These service characteristics therefore vary for conventional and high-speed rail routes but the variables are identically weighted during calculations of generalized cost in skimming and mode shares in mode choice.

In order to add the AGS/Train mode into the model, the proposed routes and stations are coded into the input transit network. Service characteristics are calculated based on a given scenario's operating plan and translated as needed into DRCOG model inputs:

- Routes are assigned peak and off-peak headways corresponding to daily frequencies.
- Rail links traversed by each route are assigned speeds corresponding to the travel time and distance between adjacent stations.
- Distance-based fares are converted into zone-based fares corresponding to every high-speed rail station pair.
- Stations are assigned to nodes, most of which are coded as park-n-ride facilities. The nodes are also connected to highway links and nearby transit stations via walk and drive access links.

Other than the network edits associated with the addition of the AGS/Train mode, all future year DRCOG model inputs remain as-is, including the zone system, socioeconomic data and forecasts, and future highway and transit project assumptions.

Additional functionality is added to the DRCOG model to report AGS/Train-specific model outputs. Daily AGS/Train station pair ridership and revenues are generated and annualized using a factor of 315, reflecting an assumption that weekend service levels will be 50% of weekday service levels on average.

Results of the initial runs of the DRCOG model with the proposed AGS/Train routes revealed that some of the AGS/Train markets receive no riders due to direct competition with light and commuter rail. In these cases, due primarily to the much lower fares of the conventional rail routes, the AGS/Train routes are not competitive enough to be included in the hyperpath selected during transit skimming. As a result, the transit assignment of rail trips resembles more of an "all-or-nothing" approach, with transit ridership assigned to only one route—conventional rail. In reality, however, if more than one rail route serves a given market, some transit users would be expected to choose each option. This inconsistency is reflective of variances in traveler response to trade-offs in time and cost, which are not fully captured by the DRCOG model because its transit skimming step uses one average value of time.

In order to replicate a more realistic ridership distribution between competing conventional and AGS/Train, the DRCOG model is modified to perform transit skimming and assignment for low, medium, and high income groups separately. As mentioned, the original DRCOG model already applied the Home Based Work (HBW) mode choice models for these three income groups. To do so, the model produces HBW OD trip tables for each income group, which are subsequently multiplied by OD mode shares for the corresponding income group. This modification, therefore, goes a step further by also using transit skims unique to each income group for the assignment of HBW transit trips.

The transit skims for the low, medium, and high income groups differ due to changes made only to the value of time parameter. The value of time for the medium income group is set to the same value of time used throughout the DRCOG model, $0.20/minute ($12/hour). Using the income groups and the corresponding household income ranges defined by DRCOG, an average annual household income is estimated for each group. By proportionality, the values of time are estimated for the low and high income groups (as shown in Table 31)

TABLE 31. VOTS USED FOR MODIFIED TRANSIT SKIMMING

DRCOG Income Group	DRCOG Population Percentiles	DRCOG Annual Household (HH) Income Range	Estimated Average Annual HH Income	Estimated Average Value of Time ($/min)
Low	0% - 11%	< $15K	$11	$0.05
Medium	11% - 75%	$15K - $75K	$45K	$0.20
High	75% - 100%	>= $75K	$100K	$0.45

Modifying the model in this way served to better reflect variances in transit users' values of time, while minimally impacting the calibration and validity of the DRCOG model. This adjustment purposefully does not alter the mode choice models or their inputs in order to preserve the relative volumes of auto and transit trips. Table 32 shows DRCOG transit boardings for base runs (i.e. without the high-speed rail mode) using the original and modified DRCOG models. This comparison confirms that the DRCOG model adaption has negligible impacts on both the distribution and total volume of transit boardings.

TABLE 32. BASE VS. MODIFIED DRCOG DAILY TRANSIT BOARDINGS

DRCOG Transit Modes	DRCOG Base	DRCOG w/ varied VOT	Percent Difference
Mall Shuttle	141,423	141,195	-0.2%
Denver Local Bus	240,033	239,739	-0.1%
Limited Bus	19,015	18,872	-0.8%
Express Bus	1,064	1,062	-0.2%
Regional Bus	22,144	21,981	-0.7%
Rail	321,763	317,829	-1.2%
Skyride Bus	357	364	2.0%
Longmont Local Bus	4,235	4,228	-0.2%
Boulder Local Bus	28,577	28,622	0.2%
Total	**778,611**	**773,892**	**-0.6%**

With regards to the AGS/Train scenarios, the transit skimming/assignment modification more realistically distributes ridership across competing transit routes. The altered transit assignment reflects the preference of travelers with a low value of time for the least expensive transit modes (e.g. local bus) and travelers with a high value of time for the most expensive transit modes (e.g. rail). Within the rail mode this is especially prominent, as most of the proposed AGS/Train routes serve stations and markets very similar to those of planned conventional rail, such as RTD FasTracks routes. It is important to note, however, that the medium income group is by far the largest market, mitigating the impacts of high and low values of time on the AGS/Train forecasts.

Results

Denver area AGS/Train trips are forecast separately from the intercity AGS/Train trips using an intra-urban model. The intra-urban model is adapted from the latest TransCAD four-step travel demand model (COMPASS 4.0) developed and maintained by DRCOG. The DRCOG COMPASS model incorporates detailed inputs of the local transit service and is used by RTD for transit modeling in the Denver metro area. By modifying the DRCOG model to incorporate the AGS/Train mode, the intra-urban explicitly models the connectivity with the local transit system, an important element of demand modeling in an urban context.

The intra-urban model, adapted from the latest DRCOG COMPASS model (as discussed above), was applied for AGS/Train scenarios with varied east-west alignments between I-70 and DIA via: new track through Denver (as in A5-a/b, A1-a, and A1-b shown in Figure 31, Figure 32, and Figure 33), new track around Denver (as in B2-a and B4 shown in Figure 34 and Figure 35), and shared RTD track through Denver (as in C1 shown in Figure 36).

FIGURE 31. A5 CONFIGURATION (A VIA I-76/72ND, B VIA DUS)

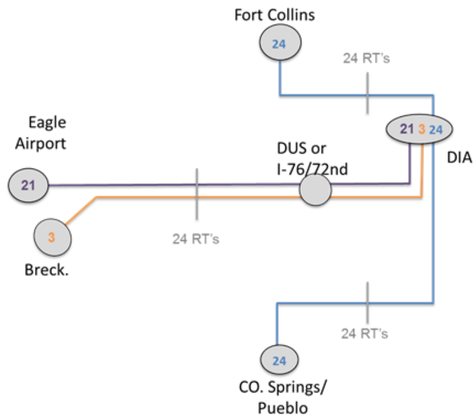


FIGURE 32. A1-A CONFIGURATION

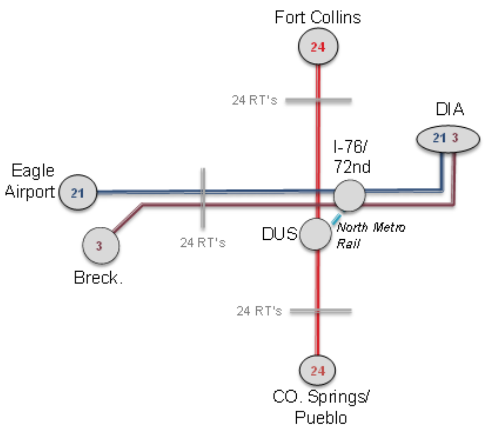


FIGURE 33. A1-B CONFIGURATION

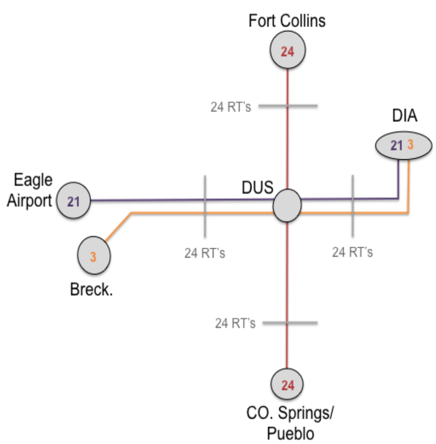


FIGURE 34. B2-A CONFIGURATION

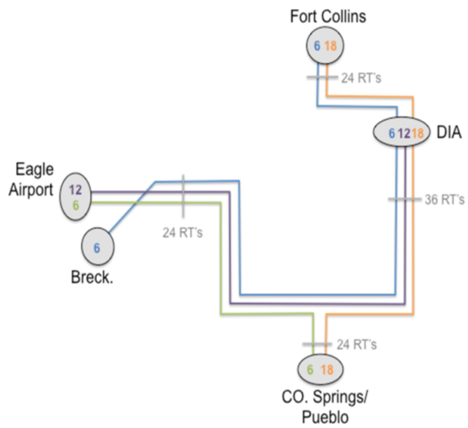


FIGURE 35. B4 CONFIGURATION

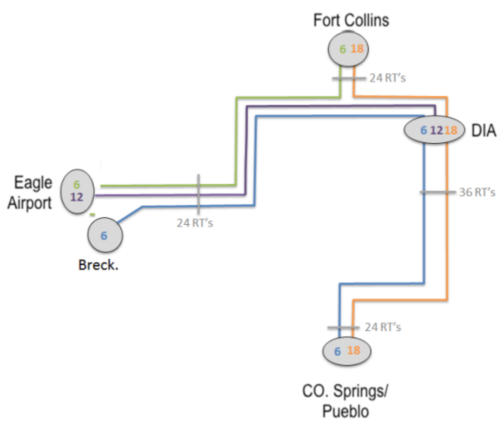
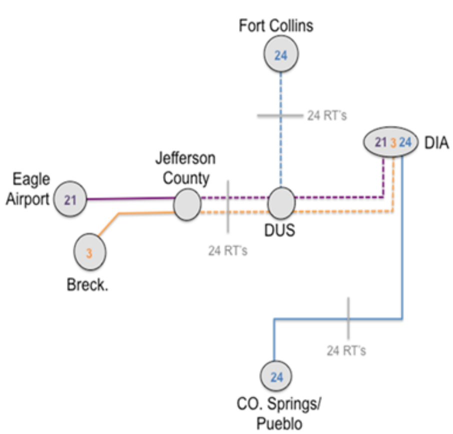


FIGURE 36. C1 CONFIGURATION



Depending on their alignment, the scenarios use a subset of nine Denver-area stations. To better understand high-level demand patterns, station pair ridership forecasts are aggregated into market pairs. The stations covered by the intra-urban model and their corresponding markets—I-25 North: I25N (Yellow), Denver metro area: DEN (Blue), I-25 South: I25S (Green), and I-70 mountain corridor: I70 (Red)—are shown in Figure 37.

FIGURE 37. INTRA-URBAN STATIONS

As seen in Table 33, 2035 AGS/Train ridership forecasts vary from 1.44M to 2.82M across the scenarios. These forecasts represent only 1.4% to 2.7% of the total rail ridership (combined existing and proposed RTD light rail and commuter rail lines as well as the AGS/Train mode) within the Denver metro area as output by the intra-urban model. Generally speaking, RTD light rail and commuter rail proves very competitive due to its extensive coverage and low fares. In many cases, the AGS/Train is competing against these RTD rail routes and is not the favored mode. Ridership forecasts for the scenarios vary depending on how well the AGS/Train mode competes (in terms of service markets) with RTD routes. Furthermore, variations in in-vehicle travel time, transfer time, frequency, and distance-based fare resulting from the different alignments impacts how competitive (in terms of service levels) the AGS/Train is with transit and auto modes.

TABLE 33. 2035 INTRA-URBAN RIDERSHIP BY MARKET

Market	A5-a	A5-a Maglev	A5-b	A1-a	A1-b	B2-a	B4	C1
I25S-I25S	923,095	923,306	923,293	896,729	896,348	825,984	938,243	924,226
I25S-DEN	810,709	810,656	792,326	454,932	507,500	777,578	867,737	806,274
I25N-DEN	758,687	758,700	759,260	5,327	7,176	939,185	939,815	797
I70-DEN	40,140	105,714	41,123	40,336	42,402	7,796	6,281	14,585
I25N-I25S	35,126	35,097	35,163	37,557	37,463	19,987	40,610	0
DEN-DEN	359	397	5,667	356	72,872	0	0	1,484
I70-I70	8,111	11,277	6,143	8,215	6,143	15,227	9,592	7,680
I70-I25S	413	624	359	9	1,868	24,863	491	19
I70-I25N	271	343	668	0	1,751	1,166	21,527	413
I25N-I25N	0	0	0	0	0	0	0	0
TOTAL	**2.58M**	**2.65M**	**2.56M**	**1.44M**	**1.57M**	**2.61M**	**2.82M**	**1.76M**

Table 33 shows the scenario with the highest ridership, B4, having almost twice that of the scenario with the lowest ridership, A1-a. The key driver of this result is the lack of a direct connection between I25N and Denver (in A1-a compared to B4), dramatically diminishing the ridership generated by this market. The I25N-DEN market contributed to nearly 70% of the difference in ridership between the two scenarios, underscoring the potential of this market for the AGS/Train mode if served directly. Similarly, the other market pairs along I25 generally exhibit significantly higher demand than the I70 markets. This trend is not surprising considering the growing population in Denver's north and south suburban areas.

Though lesser in magnitude, the I70-DEN market is also sensitive to variations in alignment. This market's lower ridership for scenarios B2-a and B4 reflects poor service characteristics due to a lack of connection with central Denver and longer alignment via a beltway to the airport (equating to longer travel times and higher distance-based fares). Scenario A5-a Maglev, on the other hand, suggests that improvements to in-vehicle travel time can help capture considerably more demand between Denver and the I70 area stations.

Table 33 also reveals a few other markets in which demand is only realized in one of the scenarios. The following conclusions can be drawn about capturing this demand:

- DEN-DEN (central Denver to the airport) demand is not negligible if service connects the north and south suburban areas into Denver, as in scenario A1-b;
- I70-I25S demand is not negligible if service connects the south suburban areas to the west via a direct route with no transfer, as in scenario B2-a; and
- I70-I25N demand is not negligible if service connects the north suburban areas to the west via a direct route with no transfer, as in scenario B4.

Station boardings/alightings, as seen in Table 34, support the inferences drawn from a market level comparison above and provide further insight into ridership patterns at a more disaggregate level. Most notably, Castle Rock generally has the highest number of station boardings and alightings across all scenarios. This result is due to the fact that Castle Rock is outside the RTD service coverage area, so the AGS/Train has no transit competition. Castle Rock's significance is further illustrated in Table 35, which shows that Castle Rock to/from Lone Tree consistently has the highest AGS/Train ridership. Lone Tree's prominence as a station is also related to this phenomena, since Castle Rock feeds AGS/Train riders to Lone Tree, where they may continue on the AGS/Train mode to their destination or transfer to another RTD transit mode.

DIA and North Suburban are also among the most popular stations, as illustrated by their high numbers of boardings and alightings in Table 34, and the pair's prevalence as a top station pair in Table 35. It is clear that by not having a direct connection between North Suburban and DIA, scenarios A1-a, A1-b, and C1 preclude a market with potentially significant demand.

Lastly, despite their shortcomings with regards to capturing demand in some key markets, scenarios A1-a and A1-b are the only scenarios to capture sizable demand to/from central Denver as a result of the presence of the Denver Union Station. As shown in Table 35, Denver Union Station to Castle Rock can generate significant ridership if the AGS/Train alignment serves central Denver.

TABLE 34. 2035 INTRA-URBAN STATION BOARDINGS AND ALIGHTINGS

Station	Market	A5-a	A5-a Maglev	A5-b	A1-a	A1-b	B2-a	B4	C1
Castle Rock	I25S	809,868	809,876	800,817	672,972	697,572	726,998	829,467	804,167
DIA	DEN	803,847	836,579	785,426	19,031	81,552	862,279	906,917	405,144
Lone Tree	I25S	536,351	536,618	536,401	470,007	472,191	510,199	563,195	523,206
North Suburban	I25N	397,042	397,070	397,546	21,442	23,195	480,169	500,976	605
Denver - Union Station	DEN	0	0	16,596	230,130	269,859	0	0	7,168
Georgetown	I70	18,445	0	16,218	18,333	17,201	16,660	16,189	11,198
Suburban West	I70	10,078	27,569	11,000	10,055	11,953	15,479	7,552	3,989
Idaho Springs	I70	0	37,049	0	0	0	0	0	0
Denver I-76/72nd	DEN	1,280	1,353	0	1,493	0	0	0	0
	Total	**2.58M**	**2.65M**	**2.56M**	**1.44M**	**1.57M**	**2.61M**	**2.82M**	**1.76M**

TABLE 35. 2035 INTRA-URBAN RIDERSHIP BY KEY STATION PAIR

Station Pair	Market	A5-a	A5-a Maglev	A5-b	A1-a	A1-b	B2-a	B4	C1
Castle Rock-Lone Tree	I25S-I25S	923,095	923,306	923,293	896,729	896,348	825,984	938,243	924,226
DIA-North Suburban	DEN-I25N	758,687	758,700	759,260	0	44	939,185	939,815	0
Castle Rock-DIA	I25S-DEN	693,939	693,740	669,970	0	71,770	621,341	718,402	682,618
Denver Union Station-Castle Rock	DEN-I25S	0	0	5,626	446,087	423,480	0	0	1,471
Lone Tree-DIA	I25S-DEN	116,767	116,903	116,730	0	1,017	156,237	149,335	122,185
Lone Tree-North Suburban	I25S-I25N	32,508	32,489	32,499	34,439	34,379	17,741	38,336	0

A few overarching ridership trends can be concluded based on the market pair ridership, station pair ridership, and station boarding results presented and described above.

- The I25 markets have more demand potential than the I70 markets. This is reasonable considering the distribution of population in and around the Denver area;
- Where the proposed AGS/Train routes serve similar markets as planned RTD rail routes, conventional RTD rail is often favored due to lower fares and the fact that the AGS/Train's speed advantage produces minimal time savings for short urban trips. For

markets where RTD rail is not an option, such as Castle Rock, AGS/Train is more attractive and generates a considerable portion of the total intra-urban demand;

- Where the proposed AGS/Train service requires a transfer, ridership is significantly reduced. This is due in part to the extensive RTD transit coverage, allowing an AGS/Train rider to easily transfer to cheaper transit modes. As an example, if a user is traveling from Castle Rock to DIA and a transfer is required at Denver Union Station, they may board the AGS/Train mode at Castle Rock but choose to transfer to a cheaper RTD rail transit route at Lone Tree or Denver Union Station to continue on their journey. If no transfer is required, however, a user would likely use the AGS/Train mode for the entirety of their route.

It is important to note that in most scenarios, trade-offs are made in terms of which market(s) to best serve. When weighing these trade-offs, consideration should also be given to ticket revenues, as the furthest station pairs generate the highest yields. It should also be kept in mind that these trade-offs may produce very different results for longer distance intercity demand, which dominates the magnitude of total ridership forecast in the entire study area. Accordingly, the intra-urban model helps to provide insight into the differences in potential demand between shorter distance markets, but the results are just one component of the forecasts.

Section 5: Ridership and Revenue Modeling for the Airport Choice (Connect Air) Market

In general, the introduction of a high-speed rail service with a station at a hub airport can produce changes in air demand levels and patterns. Air travelers who begin their trip at a regional airport and change planes at a hub airport may prefer to access the hub airport by rail, or indeed may in some cases change their choice of hub. To forecast these potential shifts, this travel demand forecasting study effort developed a new airport choice model.

Because of the attractiveness of Denver International Airport (DEN) as a hub (due to the large number of destinations served, and the presence of major carriers there), the main issue here is modeling the behavior of air travelers who begin their trip in other relevant[11] study area regional airports - Colorado Springs (COS) and Eagle County Regional (EGE) - and who have the option of taking a connecting flight at DEN to their destination. This connection at DEN may be obligatory (no other flight from the regional airports is viable) or optional (direct flights from the other airports or viable connecting flights via other hubs are available from the regional airport). When considering a connection at DEN, the choice then is whether to begin the trip at the regional airport, fly to DEN and connect there to the onward leg; or to access DEN via a surface mode (including possibly the AGS/Train mode) and begin the air leg there. Similar but reversed choices confront air travelers who end their trip in the three regional airports.

Information necessary to size this market (i.e. to determine the volume of trips between COS/EGE/PUB and other airports, including via connections at DEN) is available from data sources such as the BTS DB1B database.

The AGS/Train access to DEN may affect trips from the regional airports that have other air travel options (direct flights from COS/EGE/PUB or connecting flights via other hubs). This is highly dependent on the competitive response of the air carriers to the presence of the AGS/Train service between the regional airports and DEN (e.g. code sharing with the AGS/Train service, air carriers swapping slots for the feeder services in favor of slots for long-haul air services). The airport choice (connect air) analysis is confined to a limited number of the highest volume airport destinations from the regional airports and, for each of these, compare the non-DEN option to a connection at DEN accessed via the AGS/Train service. The comparison incorporates possible airline connections and transfer options by including trip cost, together with access, wait, transfer and line haul times, appropriately weighted, and is based on a simple model estimated from current volume shares of different routes, as obtained from USDOT DB1B and/or T-100 databases.

[11] Meaning that there are significant connecting air trips between DEN and the study area airport. Pueblo Memorial (PUB) is not mentioned here because of its very low volumes.

There are also significant seasonal variations in available air service in EGE. During the first quarter of the calendar year (winter months), there are 16 flights daily as opposed to 4 flights a day during the rest of the year in and out of EGE. The resulting variations in possible airline connections and transfer options for the air mode as well as with the AGS/Train mode is separately analyzed to account for the potential differences in rail demand between the first quarter and the rest of the year.

Connect Air Trips Candidates for Diversion to the AGS/Train Mode

A candidate connect air trip thus defined consists of an air leg (or a series of air legs) with one end outside the study corridor, connected on the other end to an AGS/Train leg within the corridor. An example of such a trip originating at Eagle County Regional Airport (EGE) and ending in Orlando (MCO) is shown in Figure 38.

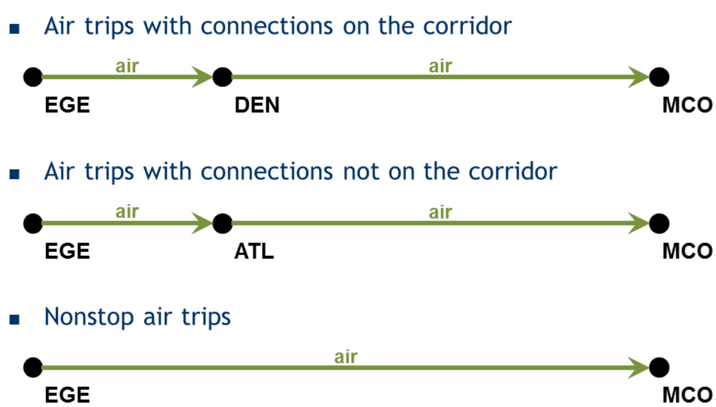
FIGURE 38. EXAMPLE OF A CONNECT AIR TRIP AT EAGLE COUNTY REGIONAL AIRPORT (EGE)

Connect air trips require an AGS/Train station at or near the connecting airports (EGE or COS). Connect air trips can be diverted from 3 main sources:

- Air trips with connections on the corridor (e.g., EGE – DEN – MCO)
- Air trips with connections not on the corridor (e.g., EGE – ATL – MCO)
- Nonstop air trips (e.g., EGE – MCO)

Each connect air trip has the potential to be switching to AGS/Train for the first or last leg of their journey. These sources of diverted connect air trips are illustrated in Figure 39 for the EGE – MCO example.

FIGURE 39. SOURCE OF DIVERTED CONNECT AIR TRIP – THE EGE EXAMPLE



The main issue is modeling the behavior of air travelers who begin (or end) their trip at COS or EGE airports and who have the option of taking a connecting flight at DEN to (or from) their destination (origin). There are currently more than 650,000 annual connecting itineraries originating at the two corridor airports (EGE and COS). These are shown in Table 36.

TABLE 36. ANNUAL CONNECTING ITINERARIES ORIGINATING AT CORRIDOR AIRPORTS

COS	EGE	Total
573,790	93,910	667,700

Source: SDG analysis

Connect Air Itinerary Choice Model

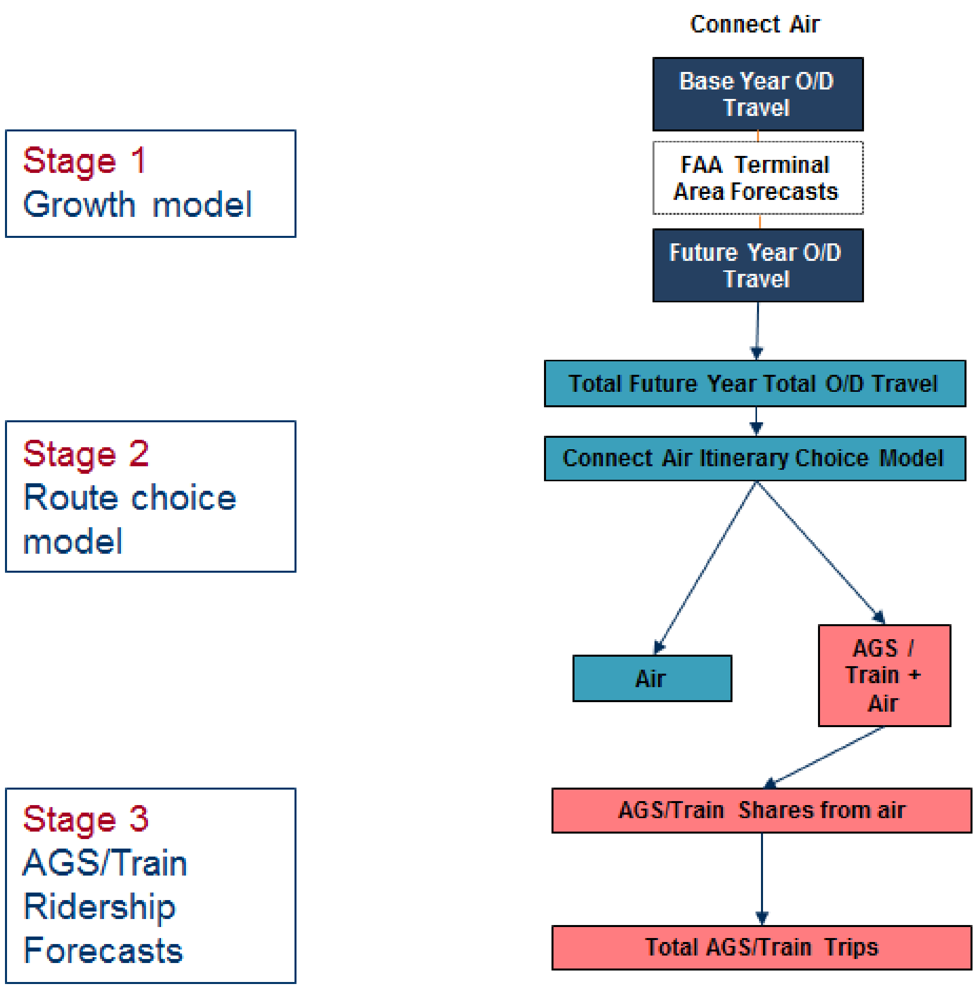
When considering a connection at DEN, the choice is whether to:

- begin (end) the air trip at EGE or COS,
- fly to (from) DEN and connect there to the onward leg by air, or
- fly to (from) DEN and connect there to the onward leg via the proposed AGS/Train mode.

An itinerary choice model is estimated to predict the share of connect air travelers at EGE and COS who would use the AGS/Train to (from) Denver. The overall structure of the connect air itinerary model is shown in Figure 40.

However, before the application of the newly developed itinerary choice model, the connect air trip table is grown to 2035 first. 2035 connect air trip tables are prepared based on published FAA Terminal Area forecasts of total annual airport enplanements for 2035. Factors are applied to grow the base airport pair volumes to 2035 in a way that is consistent with the FAA airport-level totals.

FIGURE 40. CONNECT AIR ITINERARY CHOICE MODEL STRUCTURE



The estimation dataset is based on revealed air traveler route preferences data for the EGE and COS airports. The application dataset also merge together current air itineraries and AGS/Train schedules, finding all the possible connections between the AGS/Train schedule and current air services. This is done assuming a 90-210 minute feasible connection time window between the air and AGS/Train modes and an additional 60-minute security time for itineraries with air to air connections. Figure 41 illustrates these assumptions for the AGS/Train- air itinerary EGE-DEN-MCO.

FIGURE 41. CONNECTIONS BETWEEN THE AGS/TRAIN SCHEDULE AND THE AIR SERVICES

A mathematical model is estimated using real choices made by travelers as recorded in US DOT databases. The itinerary choice model estimated is based on revealed air traveler route preferences data for the EGE and COS airports. It compares the connecting by air option to a connection accessed via AGS/Train at DEN. This comparison incorporates trip cost, together with access, wait, transfer and line haul times, appropriately weighted and revealed preferences using volume shares of current air routes as obtained from DB1B sources. Table 37 shows the itinerary choice model coefficients as estimated by SDG.

TABLE 37. CONNECT AIR ITINERARY CHOICE MODEL COEFFICIENTS

Name	Value	Std err	t-test	p-value
Denver constant	0.38500	0.10100	3.80	0
Fare ($)	-0.00547	0.00043	-12.67	0
Frequency	0.04290	0.00251	17.06	0
Time (min)	-0.00504	0.00060	-8.36	0

Source: SDG analysis, adj. rho squared: 10%

The estimated value of time of $55/hr validates well against USDOT benchmarks. The model is applied to predict the probability of a traveler choosing each itinerary, given the fares, travel times, etc., for each option. These probabilities are then multiplied by the connect air trips (as shown in Table 36) to obtain the possible AGS/Train trips in the airport choice (connect air) market.

Finally, once the diversions of the connect air trips to the AGS/Train mode are calculated through the application of the itinerary choice model, the 2035 AGS/Train trips between EGE and DEN and COS and DEN are distributed to the zone levels at the EGE and COS ends (zones within the catchment area of Eagle County airport and Colorado Springs stations) based on forecast population distribution among the zones in 2035.

Appendix E:

Sources of Funding: Interregional Connectivity Study for High Speed Intercity Passenger Rail (HSIPR) in Colorado

Sources of Funding:

Interregional Connectivity Study for High Speed Intercity Passenger Rail (HSIPR) in Colorado

Executive Summary

The Colorado Department of Transportation (CDOT) Department of Transit and Rail is evaluating the feasibility of High Speed Intercity Passenger Rail (HSIPR), and considering Advanced Guideway System (AGS) technologies to improve statewide interregional connectivity. The project study area includes alignments from Denver International Airport to Eagle County Airport (140 miles from east to west) and from Fort Collins to Pueblo (160 miles from north to south). Project costs are anticipated to range from \$50 to \$100 million per mile resulting in a potential program cost from \$16 billion to \$33 billion. Depending on timing, the cost of money and the ultimate cost per mile, the annual capital requirement could range from \$1.0 to \$2.5 billion per year, assuming full program construction.

It is anticipated, however, that the project would be phased in a series of Minimum Operational Segments (MOS). It is also anticipated that 50% of the capital cost would be in the form of federal grants, thus halving the local capital requirement. How much money must be generated locally and what is a reasonable MOS? For example, assuming that a minimum best first project is likely from \$1 billion to \$3 billion in 2013 dollars, the capital recovery (the annual payment on the bonds also referred to as the capital recovery factor)[1] will range between just under 6% to around 8% of the loan value, depending on the interest rate assumed. For a project of \$1 billion, assuming a 50% federal grant, the citizens of Colorado would need to fund \$500 million at a cost of \$35 to \$40 million per year over a 30 year period. A \$3 billion project would be three times this amount and so forth.

The purpose of this white paper is to determine what types of new funding sources, such as user fees and taxes, are needed to generate this additional revenue. **It is not anticipated that these sources would all be implemented or that they might be implemented at the levels evaluated. Rather the intent of this white paper is to reveal the possible major funding sources that could be considered.**

Colorado State Budget

Colorado's entire state budget totaled approximately \$25.5 billion in Fiscal Year (FY) 2010-2011. The General Fund portion of the budget (\$8 billion) is funded primarily from income and sales taxes and supports the core operations of the state government. Cash Funds (\$8.9 billion) are typically earmarked for specific programs which are related to the revenue source. Federal Grants and Contracts (\$8.4 billion) are tied to specific programs such as Medicaid.

Colorado Department of Transportation

The Department of Transportation budget was approximately \$1.3 billion in FY 2010-2011. CDOT receives no General Fund revenues from the state government.

[1] For example, assuming an interest rate of 4%, the capital recovery factor, A/P, is 5.78%; for 6% interest, the factor is 7.26% and for 8% interest the factor is 8.88 %.

Revenues - The majority of CDOT revenues are generated from the following sources:

- *Highway Users Tax Fund (HUTF)* – is the state's motor fuels tax and a major ongoing source of revenue for CDOT. CDOT received approximately $404.9 million from this source in FY 2010-2011.
- *Federal Funds* – President Obama signed MAP-21, the Moving Ahead for Progress in the 21st Century Act into law on July 6, 2012, which authorizes funds to be expended from the (HTF) Highway Trust Fund (motor fuels and truck related excise taxes) for transportation. Colorado's share in FY 2011 was estimated at $526.3 million.
- *American Recovery and Reinvestment Act (ARRA)* –Passed in 2009 as an economic stimulus measure, ARRA directed $46.5 billion towards transportation related improvements. Colorado received $550 million. The majority of the resulting projects have been completed. ARRA also established the Transportation Investment Generating Economic Recovery (TIGER) which has also funded recent transportation improvements.
- *Senate Bill 09-108 (FASTER)* - Signed into Colorado law in 2009, FASTER, which is the Funding Advancement for Surface Transportation & Economic Recovery, raises money for bridge reconstruction, highway safety projects and transit primarily through an increase in vehicle-registration fees. FASTER is anticipated to generate approximately $292 million per year to 2035 with a minimum of $15 million for transit.
- *Senate Bill 09-228* - In 2009 the legislature passed Senate Bill 09-228 which established methods to transfer money to transportation, capital construction, and the statutory reserve. CDOT does not anticipate funds being made available for transportation under this new law until at least FY 2013 - 2014.

Investments - The Colorado Department of Transportation has developed a funding decision-making process based on investment categories and goals. Projects and programs fall in the following categories.

- *Safety* - Projects and programs to reduce fatalities, injuries and property damage
- *System Quality* - Activities, projects and programs to maintain physical function and aesthetics
- *Mobility* –Projects, services and programs to enhance the movement of people, goods and information
- *Program Delivery*– Functions that enable the delivery of CDOT's programs, projects and services
- *Strategic Projects(Debt Service)* - High-priority, statewide projects

Funding Sources

2011 revenues either currently or potentially appropriate for transportation needs in the counties and jurisdictions which would most directly benefit from HSIPR include revenues collected for motor fuel taxes, vehicle registrations, state sales taxes, state income taxes, property taxes, and state lottery profits. Although total receipts were significant at over $7 billion, all sources are currently used for a wide variety of either general government services or specific programs. State income taxes and state sales taxes generated the greatest revenues.

Future Revenue Sources for HSIPR

In order to begin identifying major funding sources for HSIPR, an analysis of potential sources was undertaken, assuming an increase or change in current revenues collected in the counties and municipalities in the study area. This is not to suggest that the sources evaluated will be implemented. There are significant political, operational, and other hurdles and considerations that must be taken into account. However, it begins to suggest the possible funding sources that could be considered and the potential magnitude of revenue potentials. They are summarized as follows:

Sources	***Increase / Change***	***Revenues Generated***
User Fees		
Farebox Revenues	-- to be determined --	-- to be determined --
Motor Fuel Purchase Tax Increase	$.25 per gallon	$446.9 million
VMT Fees	$.01 per mile	$392.9 million
Increase in Vehicle Registration Fees	$100 per vehicle	$391.3 million
Utility Fees	$15 per month per household	$293.6 million
General Revenues		
Increased State Sales Tax	1%	$571.9 million
Increased State Property Tax	4 mills	$200.1 million
Increased State Income Tax	1%	$1,044.1 million
Lodging Tax	1% of current statewide lodging spending	$26.5 million
Change in Lottery Tax Allocation	Reallocation of 10% of lottery program profits	$11.3 million
Value Capture Mechanisms		
Development Fee	$10,000 per residential unit and 1% fee on the value of commercial development	$169.4 million
Total		**$3,548.0 million**

Project Leadership Team Reaction to Possible Sources of Funding

On February 26, 2013 the project team presented the funding options above to the PLT. The PLT was asked to "score" them, primarily focusing on whether the source was equitable and politically acceptable. The most acceptable revenue sources other than transit fares were those that taxed non-residents such as lodging taxes or could be perceived as 'sin taxes' ie lottery taxes. Sales, income, property, motor fuels, and VMT taxes were not ranked highly by the PLT, although they would be very stable and potentially significant revenue generating resources.

1. Introduction and Objective

What is this project about?

The CDOT Department of Transit and Rail is evaluating the feasibility of High Speed Intercity Passenger Rail (HSIPR), and considering Advanced Guideway System (AGS) technologies, to improve statewide interregional connectivity. The project study area includes alignments from Denver International Airport to Eagle County Airport, approximately 140 miles in the east-west direction and from Fort Collins to Pueblo, about 160 miles, in the north-south direction. Project costs are anticipated to range from $50 to $100 million per mile resulting in a potential program cost from a low of $16 billion to a high of $33 billion. Depending on timing, the cost of money and the ultimate cost per mile, the annual capital requirement could range from $1.0 to $2.5 billion per year, assuming the full program was to be constructed.

However, it is anticipated that the project would be phased in a series of Minimum Operational Segments (MOS) to better match potential revenues with capital requirements. Further, it is also anticipated that fifty percent of the capital cost would be received in the form of federal grants, thus halving the local capital requirement. So how much money must be generated locally? There have been some discussions on what constitutes a reasonable MOS. Our ICS study process is determining a best first project as this white paper is being prepared. For the purposes of example, we can assume that a minimum project is likely from $1 billion to $3 billion in 2013 dollars. The selection of the MOS will be based on benefit/cost analysis, public support and other factors such as potential environmental impacts. In general, what is called the capital recovery (in essence the annual payment on the bonds also referred as the capital recovery factor)[2] will range between just under 6 percent to around 8 percent of the loan value, depending on the interest rate assumed. For a project of $1 billion, assuming a 50 percent federal grant, the citizens of Colorado would need to fund $500 million at a cost of $35 to $40 million per year over a 30 year period. A $3 billion project would be three times this amount and so forth.

Purpose of this White Paper

The purpose of this white paper is to determine what types of new funding sources, such as user fees and taxes, are needed to generate this additional revenue. It is recognized that many of the funding sources overlap. For instance a gas tax or mileage-based tax might be implemented, but not both: two different approaches for the same thing. Neither is it anticipated that all of these sources would be implemented, nor that they might be implemented at the levels evaluated. Rather the intent of this white paper is to reveal the possible major funding sources that could be considered.

2. State of the State

Colorado's entire state budget totaled approximately $25.5 billion in FY 2010-2011. Revenues are divided into the following broad categories and include:

- General Fund: The General Fund which supports the core operations of the state government is approximately $8 billion and is funded primarily from income and sales taxes.
- Cash Funds: Other state taxes, fees, and fines flow into special purpose "cash funds" outside of the General Fund. Money collected from motor-fuel taxes for the Highway Users Tax Fund, for example, goes into the "cash fund" to pay for transportation projects. These funds totaled approximately $8.9 billion in FY 2010-2011.

[2] For example, assuming an interest rate of 4%, the capital recovery factor, A/P, is 5.78 percent; for 6% interest, the factor is 7.26% and for 8% interest the factor is 8.88 percent.

- Federal Grants and Contracts: Significant funds come from the federal government ($8.4 billion in FY 2010-2011), although most of it is tied to specific programs such as Medicaid.

2.1 General Fund Revenues

General Funds are those funds the state receives from general tax revenues, such as the state sales and income taxes, and can be used to pay for any state program or operation. It is, in many ways, the least restrictive of the state's funding categories, and therefore, the most competitive.

General Fund Revenues primarily come from individual income and sales taxes.

CATEGORY	FY 2010-2011 ($Millions)
Sales and Use	$2,293.8
Excise Taxes	$93.9
Other Taxes	$198.1
Other Revenue	$36.9
Income Taxes	$5,515.3
GENERAL FUND REVENUES	**$8,138.0**

Source: State of Colorado Legislative Council

2.2 Cash Fund

Cash Funds are separate funds received from taxes, fees and fines that are earmarked for specific programs and are typically related to the identified revenue source. Funds typically pay for the programs for which the revenues are collected. Examples include the Hospital Provider Fee, the Highway Users Tax Fund, the Wildlife Cash Fund and funds for Higher Education tuition. Other revenues include the Severance Tax (mining), gaming revenue, and unemployment insurance related revenues. In FY 2010-2011, total cash funds equaled an estimated $8.9 billion with transportation-related funding equaling approximately $1.2 billion.

CATEGORY	FY 2010-2011 ($Millions)
Transportation-Related	$1,213.70
Resource Extraction	$234.20
Hospital Provider Fee	$586.50
Limited Gaming	$104.80
Higher Education	$3,397.00
Workers Compensation	$26.50
Unemployment Insurance	$410.20
State Lottery	$504.00
Other	$2,469.60
TOTAL CASH FUNDS	**$8,946.50**

Source: State of Colorado Legislative Council

Transportation-related cash revenue can be further broken down as follows:

Transportation-Related Funds (subject to TABOR)	FY 2010-2011 ($Millions)
Highway Users Tax Fund (HUTF)	
Motor Fuel and Special Fuel Taxes	$557.2
Registrations	$322.1
Registrations	*$185.0*
Road Safety Surcharge	*$114.5*
Late Registration Fees	*$22.7*
Other HUTF	$57.6
Total HUTF	**$936.9**
State Highway Fund	$42.6
Other Transportation	$103.2
Aviation Fund	*$36.2*
Law Enforcement	*$11.0*
Registration	*$56.0*
Total Transportation Funds (subject to TABOR)	**$1,082.7**
Other TABOR-Exempt Transportation Funds (FASTER)	$71.0
Other Transportation	$60.0
TOTAL CASH FUND TRANSPORTATION REVENUES	**$1,213.7**

Source: Focus Colorado: Economic and Revenue Forecast Colorado Legislative Council Staff, Economics Section, March 19, 2012

2.3 Federal Grants and Contracts

The state also receives funds from the federal government, originally collected from taxpayers, including grants for social, educational, and environmental purposes which funds both direct state expenditures and pass-through assistance to local governments. These funds are exempt from the TABOR revenue limit. These funds must be spent as the federal government requires. In FY 2010-2011, Transportation received approximately $641.5 million under this category. Total Federal government grants and contracts equaled $8.4 billion.

CATEGORY	FY 2010-2011 ($Millions)
Corrections	$5.3
Education	$617.9
Higher Education	$1,333.0
Human Services	$1,498.7
Judicial	$10.1
Health Care Policy and Financing	$2,532.1
Transportation	$641.5
Labor	$1,027.4
Other	$722.4
Total	**$8,388.4**

Source: State of Colorado Legislative Council

2.4 Description of Expenditures and Priorities by Department

The following table shows the expenditures by department for FY 2010-2011. Although the expenditure information is divided into General, Cash, Federal, and Transfers categories, its categories are tracked somewhat differently than the revenues described above so cannot be directly compared. The "Transfer" category represents all of the revenue that one department gets in the form of transfers from other departments. For example, if state agencies use a portion of the funds appropriated to them to purchase legal services from the Department of Law (Attorney General's office), this revenue would be identified as "transferred". Health Care Policy and Planning, and Education have the largest budgets at $4.8 billion and $4.5 billion respectively.

2.4.1 Agriculture

The Department of Agriculture works "to strengthen and advance Colorado's agriculture industry; ensure a safe, high quality, and sustainable food supply; and protects consumers, the environment, and natural resources." It has seven divisions including Animal Industry, Brands, Colorado State Fair, Conservation Services, Inspection and Consumer Services, Markets and Plants. Its FY 2010-2011 expenditures were $21 billion. There were 103 employees.

Expenditures by Department 2010-2011 ($ millions)	General	Cash	Federal	Transfers	Total
Agriculture	$5	$27	$6	-$2	$36
Corrections	$665	$93	$3	-$12	$750
Education	$2,963	$3,535	$888	-$2,899	$4,486
Governor	$11	$183	$360	-$20	$534
Health Care Policy and Planning	$1,271	$1,435	$2,804	-$689	$4,822
Higher Education	$718	$3,208	$499	-$288	$4,137
Human Services	$627	$291	$1,537	-$24	$2,431
Judicial	$325	$270	$10	-$78	$527
Labor and Employment	$0	$910	$1,464	-$55	$2,320
Law	$9	$41	$2	-$5	$47
Legislature	$32	$3	$0	-$2	$33
Local Affairs	$11	$268	$86	-$102	$262
Military and Veteran Affairs	$8	$11	$28	-$4	$43
Natural Resources	$26	$420	$41	-$176	$311
Personnel and Administration	$8	$430	$0	-$9	$430
Public Health and Environment	$27	$193	$260	-$65	$416
Public Safety	$82	$133	$38	-$10	$242
Regulatory Agencies	$2	$72	$2	-$11	$65
Revenue	$177	$752	$2	-$273	$658
State	$0	$19	$1	$0	$20
Transportation	$1	$770	$695	-$175	$1,290
Treasury	$6	$1,669	$164	-$1,423	$416
Transfers Not Appropriated By Dept	$304	$15	$0	-$319	$0
Total	**$7,278**	**$14,746**	**$8,893**	**-$6,641**	**$24,277**

Source: State Taxpayer Accountability Report (STAR) FY 2010-2011, State Controller's Office

2.4.2 Corrections

With expenditures of approximately $750 million in FY 2010-2011, the Department operates 21 state-owned correctional facilities, employs 6,200 persons, houses and supervises 22,610 offenders and supervises 8,483 parolees. Until recently the Department of Corrections budget represented one of the fastest-growing portions of Colorado's General Fund corresponding with a huge increase in the number of inmates and parolees. Since FY 2006-2007, however, the state inmate population growth has slowed corresponding to a national decrease in the number of people incarcerated.

2.4.3 Education

The department provides leadership, resources, and support for the state's 178 school districts, 1,600 schools, and over 130,000 educators for the state's 840,000 public school students. Its expenditures were approximately $4.5 billion with nearly 500 employees in FY 2010-2011. The funding of public elementary and secondary schools has long been the largest single line-item appropriation in the states' General Fund budget.

2.4.4 Governor

In addition to the administrative offices supporting the Governor, the office includes the Governor's Energy Office, the Lieutenant Governor's office, the Office of State Planning and Budgeting, the Office of Economic Development and International Trade, and the Office of Information Technology. Its expenditures of $534 million supported 990 employees in FY 2010-2011.

2.4.5 Health Care Policy and Financing

Responsible for administering the Medicaid program, the State Child Health Insurance program and a number of other programs, the department has been hard hit by additional cases, mostly Medicaid low-income children and adults due to an increase in the state population, and continued high unemployment. In FY 2010-2011, there were 271 employees and expenditures of $4.8 billion. The state's Medicaid expenditures have grown greatly over the last twenty years and are expected to grow exponentially in the near future driven by demographics, economic conditions, and health care costs. Approximately 553,000 Coloradans or 10.5% of the state's population were enrolled in FY 2010-2011.

2.4.6 Higher Education

The department serves as the central administrative and coordinating agency for higher education in the state with over 160,000 students in 28 public institutions, 3 vocational schools, 330 occupational schools and over 100 private degree authorizing institutions. In FY 2010-2011, it expended $4.1 billion and employed 21,500 persons.

2.4.7 Human Services

With about 5,000 employees and expenditures of $2.4 billion in FY 2010-2011, the department serves the most vulnerable population including struggling families, those who need safe and affordable child care, at risk children, those who need help with mental illness or substance abuse issues; and families who need assistance with caring for their veteran parents.

2.4.8 Judicial

The department interprets and administers the law through the courts in civil and criminal cases. The four primary courts in Colorado are the County Courts, District Courts, the Court of Appeals, and the Supreme Court. The department spent approximately $527 million in FY 2010-2011 and employed 4,100 persons.

2.4.9 Labor and Employment

With $2.3 billion in expenditures and 985 employees in FY 2010-2011, the department is responsible for a variety of regulatory functions related to employment, labor, and worker safety. It also administers the Unemployment Insurance program as well as various workforce programs and has seen elevated demand for both as a result of the recession. The state borrowed approximately $450 million from the federal government to pay unemployment benefits and is investigating options to paying back these loans.

2.4.10 Law

The department is the office of the Attorney General. Its departments include Consumer Protection, Criminal Justice, State Services, Business & Licensing, Civil Litigation and Employment, Natural Resources, and Administration. It employed over 450 attorneys and other staff with expenditures of approximately $47 million in FY 2010-2011.

2.4.11 Legislature

The office supports the legislative body, the Colorado General Assembly, made up of two houses, the House of Representatives and the Senate. It expended $33 million and employed 270 persons in FY 2010-2011.

2.4.12 Local Affairs

The department is the state agency link between the state and local communities. It provides training, technical assistance and financial support to local communities and leaders. It had expenditures of approximately $262 million and employed 190 persons in FY 2010-2011.

2.4.13 Military and Veterans Affairs

The office provides assistance and protection in the event of emergencies and disasters, assists Colorado veterans, and houses the state's Civil Air Patrol. Its budget of $43 million employed 1,385 persons in FY 2010-2011.

2.4.14 Natural Resources

The mission of the department is to "develop, preserve and enhance Colorado's natural resources…." The department is responsible for the management of the water, land, wildlife, minerals, energy/geology/oil and gas, state trust lands, and outdoor recreational resources. Its budget of $311 million employed 1,470 persons in FY 2010-2011.

2.4.15 Personnel and Administration

The office provides centralized administrative services to state agencies including personnel administration, insurance, management and oversight of state purchasing, administrative law judge services, development of statewide compensation and operating expense policies, and statewide central services such as travel, mail, data entry, facility maintenance, fleet operations, etc. It expended $430 million with 395 employees in FY 2010-2011.

2.4.16 Public Health and Environment

The department's mission is to "protect and improve the health of Colorado's people and the quality of its environment." Its Environmental Division oversees air pollution, water quality, and hazardous materials while its Health Division focuses on broad disease control, and health prevention programs and measures. The department's expenditures in FY 2010-2011 were $416 million with 1,290 employees.

2.4.17 Public Safety

The department promotes, maintains and enhances public safety. Its divisions include the Colorado State Patrol, the Colorado Bureau of Investigation, the Division of Criminal Justice, the Division of Fire Prevention and Control, and the Division of Homeland Security and Emergency Management. Its expenditures of $242 million in FY 2010-2011 employed 1,370 persons.

2.4.18 Regulatory Agencies

The department is the consumer protection agency for the state. It regulates state-chartered financial institutions, public utilities, insurance providers, professional occupations, and enforces civil rights laws. It expended $65 million in FY 2010-2011 and employed 590 persons.

2.4.19 Revenue

The department is responsible for the collection of revenues, issuing licenses, and overseeing the state's vehicle registrations, enforcing size and weight limits on Colorado's highways, and regulating the liquor, tobacco, gaming, racing, auto and medical marijuana industries. In FY 2010-2011, department expenditures were $658 million. There were nearly 1,300 employees.

2.4.20 State

The Secretary of State provides for the licensing of businesses, and oversees, monitors, and administers the electoral process in the state of Colorado. Its FY 2010-2011 expenditures of $20 million were funded through revenue from business filings.

2.4.21 Transportation

CDOT plans for, constructs, operates, and maintains the state transportation system including state highways and bridges. In FY 2010-2011, the department spent $1.3 billion and employed 3,140 persons. The department receives no general fund appropriations from the state.

2.4.22 Treasury

The department provides banking, investment, and accounting services for all funds and assets deposited in the State Treasury. It works to optimize cash flows and maximizes yields on state investments. Its expenditures of $416 million employed 31 persons in FY 2010-2011.

3. Colorado Department of Transportation

3.1 CDOT Revenues

The Colorado Department of Transportation's (CDOT) revenue is derived from the state Highway Users Tax Fund (HUTF), federal funds including the Highway Trust Fund (HTF), fees generated from vehicle registrations including those generated by SB 09-108 *(FASTER),* increased flexibility in the use of state revenues (SB 09-228), gaming funds, and capital construction funds according to CDOT's Elected Officials Guide to the Colorado Department of Transportation.

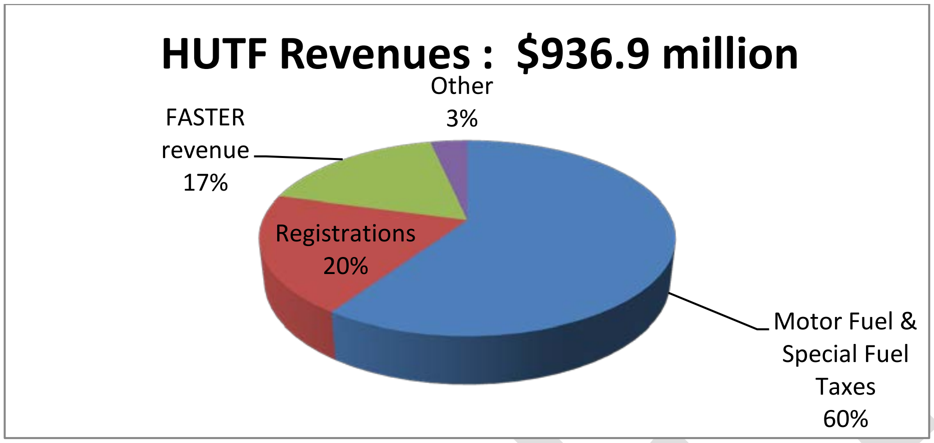
CDOT revenues in Fiscal Year 2010-2011 totaled over $1 billion with the majority of funding generated from the following sources:

- State HUTF
- Federal Funds
- American Recovery and Reinvestment Act (ARRA)
- Senate Bill 09-108 (FASTER)
- Other State Revenues

- Repealed / Previous Sources

3.2 State HUTF

The Colorado Highway Users Tax Fund (HUTF) is the major ongoing source of revenue for CDOT. In FY 2010-2011, preliminary actuals for HUTF were estimated at $936.9 million, primarily from the state's motor fuel tax, which is 22 cents per gallon of gasoline and 20.5 cents per gallon of diesel fuel.



Source: Elected Officials Guide to the Department of Transportation and Focus Colorado (Colorado Legislative Council)

The General Assembly appropriates money "off the top" from HUTF and allocates it to other programs such as Ports of Entry, the Division of Motor Vehicles, and the Department of Public Safety. The remaining dollars are distributed to CDOT, counties and municipalities.

CDOT received an estimated $404.9 million from HUTF in FY 2010-2011. HUTF funds are also distributed to the counties and municipalities within the ICS study area. In FY 2010-2011, study area counties received approximately $106.9 million while cities received $82.6 million. Denver and Broomfield distributions are counted in County totals. They are divided as follows:

County	HUTF Distributions FY 2010-2011
Adams	$7,851,861
Arapahoe	$7,885,490
Boulder	$5,430,619
Broomfield	$1,736,828
Clear Creek	$854,219
Denver	$24,514,212
Douglas	$6,852,398
Eagle	$2,085,725
El Paso	$11,220,419
Gilpin	$601,126
Jefferson	$12,865,752
Larimer	$7,508,817
Pueblo	$4,532,915
Summit	$1,086,243
Teller	$2,194,085
Weld	$9,696,161
County Totals	**$106,916,868**

Source: Colorado Department of the Treasury

City	HUTF Distributed FY 2010-2011	City	HUTF Distributed FY 2010-2011
Arvada	$3,817,073	Green Mountain Falls	$27,093
Ault	$45,347	Greenwood Village	$530,443
Aurora	$10,153,265	Grover	$10,366
Avon	$186,608	Gypsum	$230,466
Basalt	$115,878	Hudson	$71,542
Bennett	$67,968	Idaho Springs	$63,782
Berthoud	$195,584	Jamestown	$10,827
Black Hawk	$12,833	Johnstown	$338,729
Blue River	$40,326	Keenesburg	$42,658
Boone	$12,123	Kersey	$44,247
Boulder	$2,426,940	La Salle	$60,322
Bow Mar	$33,408	Lafayette	$720,494
Breckenridge	$251,569	Lakeside	$2,241
Brighton	$840,832	Lakewood	$4,765,327
Broomfield	in County totals	Larkspur	$12,424
Calhan	$30,088	Littleton	$1,297,994
Castle Pines North	$266,111	Lochbuie	$150,629
Castle Rock	$1,436,209	Lonetree	$292,070
Centennial	$4,327,053	Longmont	$2,641,270
Central City	$49,272	Louisville	$594,621
Cherry Hills Village	$241,501	Loveland	$2,484,181
Coal Creek	$15,066	Lyons	$59,942
Colorado Springs	$16,503,601	Manitou Springs	$152,484
Colmbine Valley	$44,442	Mead	$161,418
Commerce City	$1,440,257	Milliken	$205,837
Cripple Creek	$49,345	Minturn	$39,972
Dacono	$163,009	Monument	$177,627
Deer Trail	$31,968	Morrison	$10,134
Denver	in County totals	Mountain View	$10,816
Dillon	$97,323	Nederland	$52,874
Eagle	$207,585	Northglenn	$963,988
Eaton	$158,465	Nunn	$26,167
Edgewater	$106,884	Palmer Lake	$91,303
Empire	$11,635	Parker	$1,221,280
Englewood	$923,177	Pierce	$35,335
Erie	$611,710	Platteville	$107,766
Estes Park	$264,676	Ramah	$8,666
Evans	$521,604	Raymer	$9,195
Federal Heights	$221,782	Red Cliff	$10,549
Firestone	$338,709	Severance	$104,254

City	HUTF Distributed FY 2010-2011	City	HUTF Distributed FY 2010-2011
Fort Collins	$4,370,376	Sheridan	$150,078
Fort Lupton	$283,850	Silver Plume	$8,637
Fountain	$638,709	Silverthorne	$211,116
Foxfield	$38,382	Superior	$290,491
Frederick	$377,455	Thornton	$3,285,291
Frisco	$108,234	Timnath	$60,348
Garden City	$6,666	Vail	$216,318
Georgetown	$46,431	Ward	$8,181
Gilcrest	$34,585	Wellington	$184,975
Glendale	$57,356	Westminster	$3,253,293
Golden	$515,530	Wheat Ridge	$1,007,488
Greeley	$2,666,410	Windsor	$696,121
		Cities Total	**$82,618,879**

Source: Colorado Department of the Treasury

3.3 Federal Funds

3.3.1 Highway Trust Fund

The HTF is a financing mechanism, similar to other federal trust funds, established to collect tax receipts for specific purposes. HTF is comprised of excise taxes collected on motor fuels and truck-related taxes, including taxes on gasoline, diesel fuel, gasohol, and other fuels; truck tires and truck sales; and heavy vehicle use.

The HTF was originally created by the Highway Revenue Act of 1956 to ensure a dependable source of revenue for the interstate highway system. In addition to the Highway account, the Mass Transit account was established in 1983. However, more than 80 percent of the total fund is the Highway Account, including a majority of the fuel taxes as well as all truck-related taxes.

The HTF is funded primarily by a federal fuel tax, currently 18.4 cents per gallon of gasoline and 24.4 cents per gallon of diesel fuel. The Mass Transit Account usually receives 2.86 cents per gallon of the fuel taxes.

Federal legislation requires that funds paid into the fund be returned to the States for various highway and mass transit program areas in accordance with legislatively established formulas. The distribution of funding among the states has been a contentious issue. **In FY 2010-2011, Colorado users contributed $635.6 million to the fund according to FHWA**. Different methods of accounting estimate that the state typically receives 92% to 110% of its contribution. CDOT received $526.3 million from this source in FY 2010-2011.

The fund faces fiscal challenges, however. The Congressional Budget Office estimates that the HTF's Highway and Mass Transit Accounts will not be able to meet their obligations in 2015. MAP-21 did not address these issues.

3.3.2 Surface Transportation Authorization

Transportation authorization is the means through which Congress gives permission for federal funds to be expended from the HTF. Each transportation authorization bill establishes transportation policy, defines programs, outlines areas of emphasis for spending and authorizes funding to the states.

Transportation authorization legislation covers multiple years because transportation projects take a great deal of time from planning through construction. ISTEA, TEA-21, and SAFETEA-LU are the most recent example of transportation authorization bills enacted by Congress.

President Obama signed MAP-21, the Moving Ahead for Progress in the 21st Century Act (P.L. 112-141), into law on July 6, 2012. MAP-21 replaces SAFETEA-LU and funds surface transportation programs at over $105 billion for FY 2013 and 2014 with a split of 80 percent to highway funding and 20 percent to mass transit funding. Colorado's allocation for FY 2012 is $517 million. Colorado's federal highway appointments are estimated to be $517 million in FY 2013 and $522.4 million in FY 2014 under MAP-21. The state is also projected to receive approximately $10.4 million in formula funding for mass transit.

Although the MAP-21 consolidates programs, emphasizes performance management, and streamlines several environmental processes, it fails to address the long-term fiscal solvency of the HTF. Since 2008, HTF has relied on significant federal fund transfers to backfill shortfalls.

3.3.3 Earmarks

Annual appropriations legislation places yearly limits on funds that can be spent within the multi-year transportation authorization legislation. There had previously been the opportunity, also, for a certain number of specific projects or "earmarks" to be selected by Congress. That project's funding usually came from discretionary money – however, their use was controversial. MAP-21 eliminated their use.

3.3.4 ARRA and TIGER

In 2009, the Federal Government passed ARRA, the American Recovery and Reinvestment Act. As part of this $787 billion program, ARRA directed $46.5 billion towards transportation related improvements. In total, Colorado received $550 million in ARRA transportation funds with fund distribution as follows:

- Highway = $385 million
- Transit = $122 million
- New Starts Transit = $40 million

ARRA was intended to be a short term funding bill to stimulate the economy and not a long term funding solution for transportation. Half of the money was obligated by June 30, 2009 to "shovel ready projects". The majority of the CDOT projects are completed.

However, ARRA also established the Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grant program, which provides a unique opportunity for the U.S. Department of Transportation to invest in road, rail, transit and port projects that promise to achieve critical national objectives. Congress dedicated $1.5 billion for TIGER I, $600 million for TIGER II, and $526.9 million for the FY 2011 round of TIGER Grants to fund projects that have a significant impact on the Nation, a region or a metropolitan area.

In FY 2012, $500 million was allocated to the program. CDOT's I-25 North Managed Lanes Extension and Express Bus Project received $15 million towards its overall project cost of $44.3 million.

3.4 State Funds

3.4.1 Senate Bill 09-108 (FASTER)

FASTER, which stands for Funding Advancement for Surface Transportation & Economic Recovery, was signed into Colorado law in 2009. The legislation raises money for bridge reconstruction, highway safety projects and transit primarily through an increase in vehicle-registration fees. FASTER is anticipated to generate approximately $292 million per year to 2035. The law specifies that $10 million a year will be forwarded by CDOT to statewide transit projects and an additional $5 million a year for local transit projects. In 2012, the Transportation Commission awarded funds for projects including bus purchases and park-n-ride lot improvements for FY 2013.

3.4.2 Senate Bill 09-228

In 2009 the legislature passed Senate Bill 09-228 which established methods to transfer money to transportation, capital construction, and the statutory reserve. After a 5 percent growth rate is met, 2 percent of General Fund revenues at approximately $170 million (with 10 percent for transit) will be transferred to transportation for 5 years. This law also maintains a 6 percent growth limit on HUTF off-the top transfers. CDOT does not anticipate funds being made available for transportation under this new law until at least FY 2013-2014.

3.5 CDOT Allocation by Investment Category

The Colorado Department of Transportation has developed a funding decision-making process based on investment categories and goals and objectives for each investment category, using a set of performance measures and standards. Currently there are four primary investment categories which are outlined below.

- *Safety* -Services, programs and projects that reduce fatalities, injuries and property damage for all users and providers of the system
- *System Qua*lity - Activities, programs and projects that maintain the physical (integrity / condition) function and aesthetics of the existing transportation infrastructure
- *Mobility* – Programs, services, and projects that enhance the movement of people, goods and information
- *Program Deli*very – Functions that enable the successful delivery of CDOT's programs, projects and services

CDOT Expenditures in FY 2010-2011 are shown in the Figure below. The majority of expenditures were for System Quality, followed by Mobility, Safety, Program Delivery, and Strategic Projects Debt Service which is the retiring of debt service for bonds issued for 28 strategic projects identified in 1996 as high priority projects of statewide significance. Debt service on the bonds consumes $167 million of CDOT annual revenue until 2017. FASTER projects are included in the Safety and System Quality categories.

Source: CDOT Final 2011 Annual Performance Report, ArLand

4. Transportation Finance and Implementation Panel

In 2007, then Governor Bill Ritter appointed a Transportation Finance and Implementation Panel to evaluate the state's transportation needs and identify long term sustainable funding sources. The panel examined a range of potential funding mechanisms and their revenue generation potential. The 2009 FASTER legislation adopted some of the Transportation Panel's recommendations as a first step to increase statewide transportation funding by $1.5 billion annually. They included the following:

Revenue Source	Incremental Fee or Tax	Revenue Generated
Increased Vehicle Reg. Fee	$100 average fee increase	$500 million
Increased Motor Fuel Tax	$.13 per gallon	$351 million
New Daily Visitor Fee	$6 daily fee	$240 million
Increased Sales & Use Tax	.35% increase	$312 million
Increased Severance Tax	1.7% effective increase	$96 million

5. Funding Sources for High Speed Intercity Passenger Rail

Similarly, to identify a baseline revenue source for HSIPR, the 2011 revenues either currently or potentially appropriate for transportation needs in the counties and jurisdictions which would most directly benefit from HSIPR (ie the City and County of Denver and the cities and counties with corridors and stations) are first summarized with the 2011 receipts from each of the sources described. The next section will assume either a revenue increase from the same source or identify potential new funding sources with a connection to HSIPR.

5.1 Transportation Sources Baseline

5.1.1 Motor Fuel

The Colorado Highway Users Tax Fund (HUTF) is the major ongoing source of revenue for CDOT, funded primarily from the state's motor fuel tax which is 22 cents per gallon of gasoline and 20.5 cents per gallon of diesel fuel. According to the Colorado Department of Revenue, in FY 2010-2011, 2.6 billion gallons of motor fuel were sold with gallon and diesel fuel generating approximately $551 million.

Although there is variation in consumption based upon geographic area, the ICS study area is comprised of both urban and rural counties. The study area population is approximately 84% of the State population. 84% of $553 million is **$465 million, an estimate for revenues generated from our study area.**

State Motor Fuel	
Gross Gallons Total	2,992,462,336
Exemptions/Deductions Total	355,984,597
Refunds Total	43,952,756
Distributed to Other States	16,966,738
Net Gallons Total	**2,562,525,013**
Net Gasoline/Gasohol @ 22 cents	$446,669,209
Net Special Fuel @ 20.5 cents	$105,720,993
Net Aviation Gasoline @ 6 cents	$213,178
Net Aviation Jet Fuel @ 4 cents	$1,230,898
Net All Fuels Total	**$553,834,278**

Source: Colorado Department of Revenue, ArLand

5.1.2 Vehicle Registration Tax

Funds from vehicle registrations are part of the HUTF which currently help fund transportation projects in the State of Colorado. Total statewide registrations were estimated at 5 million in 2010, according to the Colorado Department of Revenue. Counties within the study area reported 3.9 million registrations in 2010, 77.5% of the statewide total.

County	2010 Vehicle Registrations
Adams	389,042
Arapahoe	479,273
Boulder	251,273
Broomfield	48,917
Clear Creek	15,453
Denver	466,342
Douglas	262,764
Eagle	59,910
El Paso	570,793
Gilpin	9,955
Jefferson	528,654
Larimer	313,933
Pueblo	161,198
Summit	33,757
Teller	33,303
Weld	288,803
County Totals	**3,913,370**
Total CO Registrations	**5,047,563**
Study Area % of State	**77.5%**

Source: Colorado Department of Revenue, ArLand

In FY 2010-2011, the State of Colorado reported fees received from registrations throughout the state as $322.1 million, broken down into regular and late registrations and road safety surcharges. **77.5% of statewide registration revenues yield $249.6 million.**

Registrations	**$322.1**
Registrations	*$185.0*
Road Safety Surcharge	*$114.5*
Late Registration Fees	*$22.7*

Source: State of Colorado Legislative Council

Statewide Registrations ($millions)	**$322.1**
Study Area percentage of State	77.5%
Estimated Revenue from Study Area Registrations ($millions)	**$249.6**

Source: ArLand

5.2 Other Baseline Government Revenues

The funds mentioned above are received from federal, state and local governments, for transportation purposes. The next set of tables outlines receipts for taxes including sales, income, property, etc., typically used for general government purposes.

5.2.1 State Retail Sales Tax Receipts

In FY 2010-2011, state sales tax receipts in study area counties equaled $1.7 billion.

County	State Sales Tax FY 2010-2011
Adams	$160,759,000
Arapahoe	$230,854,000
Boulder	$114,262,000
Broomfield	$29,947,000
Clear Creek	$2,068,000
Denver	$326,757,000
Douglas	$107,968,000
Eagle	$35,047,000
El Paso	$199,283,000
Gilpin	$2,288,000
Jefferson	$184,036,000
Larimer	$108,058,000
Pueblo	$50,008,000
Summit	$24,245,000
Teller	$5,289,000
Weld	$77,775,000
County Totals	**$1,658,644,000**

Source: Colorado Department of Revenue, ArLand

5.2.2 State Income Tax Receipts

While state income tax receipts for the entire state were estimated at $4.5 billion in 2011, county level income tax receipt information was unavailable for that year. The latest year for which that information was easily available was 2008. In that year, the state received approximately $3.5 billion in income tax receipts from taxpayers in the study area. Because of the recession, total statewide income tax receipts between 2008 and 2011 declined by 10% from $5 billion to $4.5 billion. Because income tax receipts from these counties comprise 78% of total statewide tax receipts, it is likely that income tax receipts from study area counties decreased by a similar rate to an estimated $3.1 billion in 2011.

County	State Income Tax 2008
Adams	$295,355,000
Arapahoe	$495,105,000
Boulder	$361,027,000
Broomfield	NA
Clear Creek	$3,764,000
Denver	$507,143,000
Douglas	$371,386,000
Eagle	$57,485,000
El Paso	$363,079,000
Gilpin	$3,025,000
Jefferson	$576,654,000
Larimer	$211,267,000
Pueblo	$70,379,000
Summit	$28,698,000
Teller	$12,897,000
Weld	$156,669,000
County Totals	**$3,513,933,000**

Source: Colorado Department of Revenue, ArLand

County Totals 2008	**$3,513,933,000**
2011 Estimate (assume 10% decline between 2008-2011)	**$3,162,539,700**

Source: Colorado Department of Revenue, ArLand

5.2.3 Property Tax Receipts

Total property tax receipts received in the jurisdictions noted include property taxes paid for school districts and other special purpose districts such as fire protection and metropolitan districts. These totaled $5.5 billion in 2011. However, because many of these special purpose districts are somewhat limited in their scope and operations, county and municipality receipts were selected and totaled because there is likely more flexibility to raise funds due to their more general purpose nature, and their control by public entities. County receipts equaled $1.3 billion and municipality (cities and towns) receipts equaled $283 million totaling $1.6 billion in 2011.

County	Total Property Tax Receipts (2011)	Property Tax (County Receipts, 2011)	Property Tax (Municipality Receipts, 2011)
Adams	$486,881,412	$122,569,451	$25,344,266
Arapahoe	$745,516,612	$127,903,059	$51,391,940
Boulder	$485,032,312	$138,697,525	$56,136,331
Broomfield	$114,594,120	$18,512,339	$12,112,151
Clear Creek	$37,762,137	$21,377,781	$333,774
Denver	$819,805,987	$310,831,500	---
Douglas	$475,795,574	$89,076,645	$3,226,790
Eagle	$170,330,781	$23,633,639	$9,055,225
El Paso	$439,518,138	$48,026,412	$23,605,411
Gilpin	$14,211,414	$3,434,527	$306,661
Jefferson	$672,425,610	$170,363,715	$21,020,752
Larimer	$361,665,245	$92,395,940	$29,659,970
Pueblo	$139,559,048	$49,329,042	$14,899,232
Summit	$83,041,892	$20,497,872	$4,229,062
Teller	$28,005,813	$7,083,984	$1,951,401
Weld	$383,330,046	$91,108,983	$29,820,568
County Totals	**$5,457,476,141**	**$1,334,842,414**	**$283,093,534**
County and Municipality Total			**$1,617,935,948**

Source: Colorado Department of Revenue, ArLand

5.2.4 Lottery Sales

Most of the revenues generated by the state's lottery games are designated for the State's Conservation Trust Fund and Great Outdoors Colorado (GOCO). In 2011, the lottery tax produced $420 million in overall sales with proceeds funding parks, recreation, open space, conservation, education, and wildlife projects. Profits from the sale of lottery products are mandated to be distributed according to a formula which is generally 50 percent to the GOCO Trust Fund, 40 percent to the Conservation Trust Fund, and 10 percent to The Colorado Division of Parks and Wildlife.

County	Lottery Sales 2011
Adams	$48,808,553
Arapahoe	$53,941,373
Boulder	$19,110,395
Broomfield	$5,105,995
Clear Creek	$1,067,763
Denver	$58,907,319
Douglas	$16,252,058
Eagle	$4,295,586
El Paso	$64,590,009
Gilpin	$250,923
Jefferson	$62,082,156
Larimer	$25,296,198
Pueblo	$28,708,568
Summit	$2,121,868
Teller	$2,463,115
Weld	$28,884,677
County Totals	**$421,886,556**

Source: Colorado Department of Revenue, ArLand

Lottery Fund Distribution ($millions)	**2011**
Great Outdoors Colorado (50% of profits)	$56.0
Conservation Trust Fund (40% of profits)	$45.3
Park & Outdoor Recreation (10% of profits)	$11.3
Public School Capital Construction Fund	$0.7
Total	**$113.3**

Source: Colorado Department of Revenue, ArLand

5.2.5 Revenue Summary

The sources outlined above are summarized below. While they account for significant revenue at over $7 billion, they are currently used for a wide variety of either general governmental services or specific programs, so a reallocation to HSIPR or any other program would not be possible without significant legislative changes. However, they provide a useful baseline in considering either changes or increases, with additional funds either raised or reallocated for HSIPR.

Sources	2010-2011 Estimated Receipts
Transportation	
Motor Fuel Tax	$465.2 million
Vehicle Registration	$249.6 million
General Government	
State Sales Tax	$1,658.6 million
State Income Tax	$3,162.5 million
Property Tax*	$1,617.9 million
Other Special Purpose	
State Lottery Profits	$113.3 million
TOTAL	**$7,267.1 million**

** The County and Municipality portion of Property Tax only. While total statewide property tax receipts are $5.5 billion, the remainder is dedicated to special districts including school and other special purpose districts.

Source: State of Colorado, ArLand

5.3 Future Revenue Sources for HSIPR

As we begin to consider future transportation funding for HSIPR, our previously described revenue sources can be organized into three broad categories:

1) *User fees*—such as transit fares or the gas tax—paid by direct users of transportation facilities. With user fees, the relationship between who pays and who benefits is quite clear.
2) *General Revenues* paid by the general public, such as sales or income taxes. The collection of these revenues assume that citizens benefit indirectly through the broad economic and social returns from transportation investment, so a general government fund is tapped for transportation revenue. The relationship between who pays and who benefits is less clear.
3) *Value Capture Mechanisms* - Value capture mechanisms lie in between these two categories. They target a restricted set of indirect beneficiaries: landowners and developers who benefit from the increased land value that follows a transportation improvement. Different ways to measure the value gains give rise to a range of different strategies of value capture.

As we begin to suggest either rates of increase or new funds for transportation, please note that the analysis, at this point, is being used for revenue generation sensitivity purposes and not to specifically suggest certain funding sources and rates. That is subject to further discussion.

5.3.1 User Fees

5.3.1.1 Farebox Revenues

The consultant team is in the process of developing ridership estimates as of the date of this draft. This section will be updated as those estimates, along with potential farebox revenues, are more fully developed.

5.3.1.2 Motor Fuel Tax Increase

In 2010, the motor gas consumed per capita was estimated at 422 gallons according to the U.S. Department of Energy. In the study area counties, it is estimated that 1.8 billion gallons of gas was consumed in 2010. Either assuming an increase in the current motor fuels tax or a sales tax on motor fuels consumption, an increase of $.25 per gallon yields $446.9 million annually. Equity consideration and political acceptability of such a large increase would need to be carefully considered.

County	2010 Population	Gallons of Motor Gas	$.25 per Gallon Sales Tax
Adams	441,603	186,356,466	$46,589,117
Arapahoe	572,003	241,385,266	$60,346,317
Boulder	294,567	124,307,274	$31,076,819
Broomfield	55,889	23,585,158	$5,896,290
Clear Creek	9,088	3,835,136	$958,784
Denver	600,158	253,266,676	$63,316,669
Douglas	285,465	120,466,230	$30,116,558
Eagle	52,197	22,027,134	$5,506,784
El Paso	622,263	262,594,986	$65,648,747
Gilpin	5,441	2,296,102	$574,026
Jefferson	534,543	225,577,146	$56,394,287
Larimer	299,630	126,443,860	$31,610,965
Pueblo	159,063	67,124,586	$16,781,147
Summit	27,994	11,813,468	$2,953,367
Teller	23,350	9,853,700	$2,463,425
Weld	252,825	106,692,150	$26,673,038
County Totals	**4,236,079**	**1,787,625,338**	**$446,906,335**

Source: US Census, US DOE on Motor gas consumed per capita (422 gallons in 2010)

5.3.1.3 VMT Fees

Because of fuel economy and changes in technology, Vehicles Miles Travelled (VMT) is increasingly being considered as a better measure of roadway usage. Colorado Vehicle Miles Travelled in 2011 was 46.6 billion for all roads which equals 9,275 VMT per capita. **Assuming 1 cent per mile yields $392.9 million**. One of the primary challenges to instituting this particular type of fee is the fiscal efficiency issue and the ease in which a program can be set up, since there are privacy and other concerns with respect to measuring VMTs.

County	2010 Population	VMT	1 Cent per Mile
Adams	441,603	4,095,867,825	$40,958,678
Arapahoe	572,003	5,305,327,825	$53,053,278
Boulder	294,567	2,732,108,925	$27,321,089
Broomfield	55,889	518,370,475	$5,183,705
Clear Creek	9,088	84,291,200	$842,912
Denver	600,158	5,566,465,450	$55,664,655
Douglas	285,465	2,647,687,875	$26,476,879
Eagle	52,197	484,127,175	$4,841,272
El Paso	622,263	5,771,489,325	$57,714,893
Gilpin	5,441	50,465,275	$504,653
Jefferson	534,543	4,957,886,325	$49,578,863
Larimer	299,630	2,779,068,250	$27,790,683
Pueblo	159,063	1,475,309,325	$14,753,093
Summit	27,994	259,644,350	$2,596,444
Teller	23,350	216,571,250	$2,165,713

Weld	252,825	2,344,951,875	$23,449,519
County Totals	**4,236,079**	**39,289,632,725**	**$392,896,327**

Source: Colorado Department of Transportation, US Census

5.3.1.4 Increase in Vehicle Registration Fees

Fees for vehicles are different based on the age and type of vehicle. While current registration revenues are currently devoted to HUTF, an increase of $100 per vehicle in the study area could generate approximately $391 million for HSIPR.

County	2010 Vehicle Registrations	$100 increase in Fee per Vehicle
Adams	389,042	$38,904,200
Arapahoe	479,273	$47,927,300
Boulder	251,273	$25,127,300
Broomfield	48,917	$4,891,700
Clear Creek	15,453	$1,545,300
Denver	466,342	$46,634,200
Douglas	262,764	$26,276,400
Eagle	59,910	$5,991,000
El Paso	570,793	$57,079,300
Gilpin	9,955	$995,500
Jefferson	528,654	$52,865,400
Larimer	313,933	$31,393,300
Pueblo	161,198	$16,119,800
Summit	33,757	$3,375,700
Teller	33,303	$3,330,300
Weld	288,803	$28,880,300
County Totals	**3,913,370**	**$391,337,000**

Source: Colorado State Department of Revenue, ArLand

5.3.1.5 Utility Fees

Transportation utility fees treat transportation networks like a utility, similar to other local services such as water and wastewater treatment that are financed primarily from user charges. The table below assumes a $15 per month per household charge, however, utility fees can be set using a number of different bases that are more closely related to transportation demand including fees that apply per unit of housing or per parking space, fees based on square footage or gross floor area, and fees that vary with the trip generation rate for a given property.

County	2010 Households	$15/month/HH
Adams	149,508	$26,911,440
Arapahoe	221,136	$39,804,480
Boulder	118,545	$21,338,100
Broomfield	20,841	$3,751,380
Clear Creek	4,031	$725,580
Denver	258,132	$46,463,760
Douglas	100,795	$18,143,100
Eagle	18,362	$3,305,160
El Paso	230,620	$41,511,600
Gilpin	2,442	$439,560
Jefferson	217,763	$39,197,340
Larimer	118,791	$21,382,380
Pueblo	61,858	$11,134,440
Summit	11,001	$1,980,180
Teller	9,051	$1,629,180
Weld	88,242	$15,883,560
County Totals	**1,631,118**	**$293,601,240**

Source: US Census Bureau

5.3.2 General Revenues

5.3.2.1 Sales Tax Increase

Sales taxes are a popular source to potentially fund transportation improvements. Based upon an extrapolation of current state sales tax receipts to total revenues, an approximate 1% tax on current total sales revenues within the study area would yield $571.9 million.

County	State Sales Tax FY 2010-2011	Total Revenues*	With 1% increase
Adams	$160,759,000	$5,543,413,793	$55,434,138
Arapahoe	$230,854,000	$7,960,482,759	$79,604,828
Boulder	$114,262,000	$3,940,068,966	$39,400,690
Broomfield	$29,947,000	$1,032,655,172	$10,326,552
Clear Creek	$2,068,000	$71,310,345	$713,103
Denver	$326,757,000	$11,267,482,759	$112,674,828
Douglas	$107,968,000	$3,723,034,483	$37,230,345
Eagle	$35,047,000	$1,208,517,241	$12,085,172
El Paso	$199,283,000	$6,871,827,586	$68,718,276
Gilpin	$2,288,000	$78,896,552	$788,966
Jefferson	$184,036,000	$6,346,068,966	$63,460,690
Larimer	$108,058,000	$3,726,137,931	$37,261,379
Pueblo	$50,008,000	$1,724,413,793	$17,244,138
Summit	$24,245,000	$836,034,483	$8,360,345
Teller	$5,289,000	$182,379,310	$1,823,793
Weld	$77,775,000	$2,681,896,552	$26,818,966
County Totals	**$1,658,644,000**	**$57,194,620,690**	**$571,946,207**

* Assumes current rate of 2.9% for the state portion of sales tax
Source: Colorado Department of Revenue, ArLand

5.3.2.2 Property Tax Increase

In addition to funding general government services, property taxes help pay for schools, special districts such as water and sanitation districts as well as other needs. They vary by geographic area. Property tax receipts in the study area totaled approximately $5.5 billion in 2011, although much of the revenue is designated for specific purposes. General government receipts in counties totaled $1.3 billion and municipalities, $283 million in 2011.

If two mills were added respectively to county receipts, $128 million would be generated. Additionally, if two mills were added to municipality receipts, $71 million would be generated. Both sources would generate $200 million.

County	Total Property Tax Receipts (2011)	Property Tax (County Receipts, 2011)	Property Tax (Municipality Receipts, 2011)	Revenues Generated (Additional 2 Mills to County Receipts	Revenues Generated (Additional 2 Mills to Municipality Receipts)
Adams	$486,881,412	$122,569,451	$25,344,266	$9,144,927	$6,982,430
Arapahoe	$745,516,612	$127,903,059	$51,391,940	$14,856,178	$12,846,589
Boulder	$485,032,312	$138,697,525	$56,136,331	$11,255,632	$9,311,746
Broomfield	$114,594,120	$18,512,339	$12,112,151	$2,114,367	$2,114,367
Clear Creek	$37,762,137	$21,377,781	$333,774	$1,123,491	$89,208
Denver	$819,805,987	$310,831,500	---	$21,874,908	---
Douglas	$475,795,574	$89,076,645	$3,226,790	$9,009,472	$3,480,940
Eagle	$170,330,781	$23,633,639	$9,055,225	$5,561,510	$2,985,986
El Paso	$439,518,138	$48,026,412	$23,605,411	$12,643,520	$9,932,425
Gilpin	$14,211,414	$3,434,527	$306,661	$698,075	$515,571
Jefferson	$672,425,610	$170,363,715	$21,020,752	$13,995,212	$8,420,960
Larimer	$361,665,245	$92,395,940	$29,659,970	$8,223,206	$6,242,220
Pueblo	$139,559,048	$49,329,042	$14,899,232	$3,118,243	$1,907,670
Summit	$83,041,892	$20,497,872	$4,229,062	$3,203,794	$1,814,194
Teller	$28,005,813	$7,083,984	$1,951,401	$966,239	$359,524
Weld	$383,330,046	$91,108,983	$29,820,568	$10,843,726	$4,436,340
County Totals	**$5,457,476,141**	**$1,334,842,414**	**$283,093,534**	**$128,632,498**	**$71,440,171**
County and Municipality Total			**$1,617,935,948**		**$200,072,669**

Source: Colorado Department of Local Affairs, ArLand

5.3.2.3 Income Tax Increase

Assuming a 10% decrease in 2008 state income tax receipts in order to derive a 2011 income tax estimate (as a result of the Great Recession) and then assuming a net 1% increase in the overall state income tax rate yields approximately $1 billion.

County	State Income Tax (Net) 2008 ($000s)	Federal AGI 2008 ($000s)	1% Increase in State Income Tax Rate ($000s)
Adams	$295,355	$9,382,122	$93,821
Arapahoe	$495,105	$16,209,589	$162,096
Boulder	$361,027	$11,573,941	$115,739
Broomfield	NA	NA	$0
Clear Creek	$3,764	$130,749	$1,307
Denver	$507,143	$16,308,937	$163,089
Douglas	$371,386	$11,412,571	$114,126
Eagle	$57,485	$1,826,222	$18,262
El Paso	$363,079	$13,055,080	$130,551
Gilpin	$3,025	$102,143	$1,021
Jefferson	$576,654	$19,055,854	$190,559
Larimer	$211,267	$7,319,894	$73,199
Pueblo	$70,379	$2,763,958	$27,640
Summit	$28,698	$944,014	$9,440
Teller	$12,897	$469,532	$4,695
Weld	$156,669	$5,459,763	$54,598
County Totals	**$3,513,933**	**$116,014,367**	**$1,160,144**
2011 Estimate (10% decrease)	**$3,162,540**	**$104,412,930**	**$1,044,129**

Source: Colorado Department of Revenue

5.3.2.4 Lodging Tax

The Colorado Tourism office engages Longswoods International annually to provide data on visitors to the state through extensive surveys. Information collected includes: data on the size of Colorado's travel market, volume of expenditures it generates, the competitive environment, etc. It found that in 2011, spending on lodging in the state from both business and personal travel equaled $2.65 billion from in-state as well as out-of-state travelers.

Counties and cities within the State of Colorado have instituted lodging taxes to fund business and marketing organization and activities. It is an additional sales tax added on to the cost of overnight accommodations, but not to the charges for food, beverage or other personal services. The City and County of Denver, for example, levies a 14.85% lodging tax to help pay for the cost of the convention center and other tourist related facilities.

Assuming that 1%of current statewide spending on lodging would be instituted; **$26.5 million annually** would be generated**.**

5.3.2.5 Lottery Tax

Although lottery sales were about $420 million in 2011, most of the funds are used to help pay for administrative expenses of administering the program. Net profits are used to fund various outdoor programs with most of it used for GoCo. If 10% of net profits were reallocated to help pay for HSIPR, **$11.3 million annually** would be generated.

5.3.3 Value Capture Mechanisms - Capturing Value Created by Transit

User fees target the direct users of the transportation infrastructure while general approaches that increase income or sales taxes assume that citizens benefit indirectly through the broad economic and social returns from transportation investments. Value capture mechanisms target a restricted set of indirect beneficiaries: landowners and developers who benefit from the increased land value that follows a transportation improvement. Ways of potentially capturing the value gains are outlined below.

- *Special Assessment* – a tax assessed against parcels that have been identified as receiving a direct and unique benefit as a result of a public project.
- *Tax Increment Financing* – a mechanism that allows the public sector to "capture" growth in sales and/or property tax resulting from new development and increasing property values.
- *Joint Development* – generally, cooperation between the public and private sectors to deliver transit-oriented development (TOD), usually involving development on transit agency owned land.
- *Developer/Impact Fee*- a fee assessed on new development within a jurisdiction as a means to raise funds to pay for infrastructure.
- *Real Estate Transfer Tax* – a tax paid as property changes ownership. It has been used as a means to raise funds for transit in the Roaring Fork Valley.

5.3.3.1 Developer Fee or other Value Capture Mechanism (proxy)

As a proxy for the various methods that can be used to raise revenues based upon an assumption that an investment in HSIPR would result in more and higher value development, annual housing permits and commercial starts were used. Housing permits were used as a proxy for housing starts. Assuming 10,000 per new residential unit would yield $133 million. Nonresidential construction starts were obtained for the State. Assuming a portion of that development for the study area and a 1% fee on the value of that construction yields $36 million. Both sources total $169.4 million.

County	5 Year Average Annual Housing Permits (2007-2011)	$10,000 per Residential Unit
Adams	862	$8,620,000
Arapahoe	1,780	$17,800,000
Boulder	664	$6,640,000
Broomfield	502	$5,020,000
Clear Creek	16	$160,000
Denver	2,333	$23,330,000
Douglas	1,343	$13,430,000
Eagle	185	$1,850,000
El Paso	2,068	$20,680,000
Gilpin	25	$250,000
Jefferson	713	$7,130,000
Larimer	1,080	$10,800,000
Pueblo	364	$3,640,000
Summit	233	$2,330,000
Teller	74	$740,000
Weld	1,068	$10,680,000
County Totals	**13,310**	**$133,100,000**

Nonresidential Construction Put in Place in Colorado	
Annual Average (07-11)	$4,425,000,00
82% ICS area v. State	$3,628,500,00
1.0% Assumed Fee for Commercial Development	**$36,285,000**
Total	**$169,385,000**

Source: US Census, ArLand

5.4 Future Revenue Summary

While this list is not exhaustive, it begins to highlight the sources with the greatest revenue generation potential. These sources total approximately $3,548.0 million which would be generated annually.

Sources	Increase / Change	Revenues Generated
User Fees		
Farebox Revenues	-- to be determined --	-- to be determined --
Motor Fuel Purchase Tax Increase	$.25 per gallon	$446.9 million
VMT Fees	$.01 per mile	$392.9 million
Increase in Vehicle Registration Fees	$100 per vehicle	$391.3 million
Utility Fees	$15 per month per household	$293.6 million
General Revenues		
Increased State Sales Tax	1%	$571.9 million
Increased State Property Tax	4 mills	$200.1 million
Increased State Income Tax	1%	$1,044.1 million
Lodging Tax	1% of current statewide lodging spending	$26.5 million
Change in Lottery Tax Allocation	Reallocation of 10% of lottery program profits	$11.3 million
Value Capture Mechanisms		
Development Fee	$10,000 per residential unit and 1% fee on the value of commercial development	$169.4 million
Total		**$3,548.0 million**

Source: ArLand

5.5 Pros and Cons of Each Source

Each of the potential funding sources has pros and cons associated with their use and administration. The pros and cons of each of the potential funding sources can be assessed as follows in the following matrix:

- *Stability* – will the revenue sources remain relatively constant with the ebb and flow of the economic cycle?
- *Revenue Potential* – Will the source generate sufficient amounts of revenue?
- *Growth Potential* – Will the source grow commensurately with inflation?
- *Transportation Efficiency* - Are the revenues structured in such a way to encourage efficient use of the transportation system?

- *Fiscal Efficiency* - Are the taxes, fees, etc. easy to collect and understand and easy to administer?
- *Equity* - Does it disproportionately impact lower income people? Do users who use the system more pay more for the benefits?
- *Political Acceptability* - Is it supported by the public? Is there a logical connection between the tax / fee and the system?
- *Impact on Competitiveness* – would the tax / fee place an onerous burden on residents, businesses and visitors creating a disincentive to live, work, or recreate in the area?

A scale of 1 to 10 can be used to create a weighted number for each of the potential criteria by revenue source. 1 represents the lowest ranking, lowest number or most negative ranking while 10 ranks the highest. 5 is neutral. The total sum would represent the overall relative attractiveness of the potential mechanism as a funding tool. The ultimate funding for HSIPR will be a combination of funding mechanisms.

	Revenue Criterion								
	Financial Effectiveness								
Revenue Source	**Stability**	**Revenue Potential**	**Growth Potential**	**Transportation Efficiency**	**Fiscal Efficiency**	**Equity**	**Political Acceptability**	**Impact on Competitiveness**	**TOTAL**
User Fees									
Transit Fares	8	4	4	5	9	5	10	5	50
Motor fuels tax increase	8	8	8	7	9	2	2	1	45
VMT Fees	8	8	8	7	7	3	2	1	44
Utility Fees	8	5	8	1	8	5	2	2	39
General Revenues									
Sales and Use Tax	9	10	10	2	9	2	2	2	46
State Income Tax	9	10	10	2	9	8	2	2	52
Property Tax	7	4	9	2	9	8	2	2	43
Lodging Tax (Visitor Fee proxy)	7	1	7	2	9	5	9	5	45
Lottery Tax Reallocation	8	1	7	2	9	5	9	9	50
Value Capture Mechanisms									
Development Fee	6	3	7	5	7	8	9	2	47

Source: Table format based on "Metropolitan-Level Transportation Funding Sources" by Institute of Transportation Studies, Berkeley, CA and ICF Consulting, December 2005, ArLand

5.6 PLT Reaction to Funding Options

On February 26, 2013 the project team presented a simplified version of the above matrix to the PLT for evaluation and comment. While the PLT primarily focused on whether the revenue source was equitable and politically acceptable, the scores above reflect the general opinion of the alternative funding sources. Transit fares received the highest support, while the rest of the revenue sources received only medium to low support from the PLT. The most acceptable revenue sources other than transit fares were those that taxed non-residents such as lodging taxes or could be perceived as 'sin taxes' ie lottery taxes. Sales, income, property, motor fuels, and VMT taxes were not ranked highly by the PLT . Despite their unpopularity with the PLT, sources such as the State Income Tax received a high score primarily because they would be very stable revenue sources with the potential to generate high amounts of revenue. The presentation generated conversation and comments regarding geographic equity. Others commented that development fees would be important to capture because of the revenues potentially generated.

6. Financing Mechanisms

Future revenues provide the basis for financing mechanisms which ultimately leverage future cash flows into upfront capital cost expenditures. There are many innovative financing concepts potentially available to fund the required capital costs. Potential financing programs are described below.

6.1 Transportation Infrastructure Financing and Innovation Act of 1998

TIFIA is an established federal credit assistance program for eligible transportation projects of national or regional significance. These include transit and passenger rail facilities, such as the California High Speed Rail project. Under TIFIA, the U.S. Department of Transportation (DOT) can provide three forms of credit assistance to eligible projects. These means of assistance include secured (or direct) loans, loan guarantees, and standby lines of credit.

The fundamental goal of TIFIA is to leverage federal funds to attract substantial private and other non-federal co-investment into projects that provide critical improvements to U.S. surface transportation. Interest rates for TIFIA loans generally reflect the government's borrowing costs, and the terms of repayment are generally favorable to project sponsors.

Update to TIFIA Loans

TIFIA Loans have been the backbone to underpin infrastructure development and project financing for US transportation projects. On July 6, 2012, MAP-21 replaced SAFETEA-LU which had been extended nine times since its expiration in 2009. The recent MAP-21 Conference Report expands the TIFIA program by authorizing a total of $1.75 billion — $750 million for FY 2013 and $1 billion for FY 2014. The bill also increases the maximum share of project costs that can be funded with TIFIA financing from 33 percent to 49 percent. It also allows TIFIA to be used to support a related set of projects and to set aside funding for projects in rural areas at more favorable terms, and requires the Transportation Department to submit a report summarizing the financial performance of projects that are receiving TIFIA assistance. Current Colorado state law for P3 (§43-1-1202) has no express provision against the use of TIFIA in the support of financing projects. This expansion to TIFIA could play a significant role in financing HSIPR.

6.2 Railroad Rehabilitation and Improvement Financing Program (RRIF)

The RRIF program is a revolving loan and loan guarantee program that is administered by the Federal Railroad Administration (FRA). It is legislatively enabled to issue up to $35 billion in loans. The program originally was established by the Transportation Equity Act for the 21st Century (TEA-21), and was amended by the Safe Accountable, Flexible and Efficient Transportation Act: a Legacy for Users (SAFETEA-LU).

Funding from RRIF may be used to acquire, improve or rehabilitate intermodal or rail equipment or facilities, including track, components of track, bridges, yards, buildings, and shops. Funds also may refinance outstanding debt incurred for those purposes listed previously, or may be allocated to develop or establish new intermodal railroad facilities.

Attractive interest rates, similar to those available under TIFIA, also exist under RRIF. This program is able to fund up to 100 percent of a project's costs, allows for a five-year grace period, and requires the payment of an up-front risk premium.

A RRIF loan could be combined with a TIFIA loan. This combination of loans is being used at Denver Union Station. It is important to note that these sources are loans and will need to be repaid.

6.3 Private Activity bonds

Private Activity Bonds are tax-exempt bonds that are issued by the state or local government on behalf of a private entity. Their purpose is to facilitate private investment for projects that generate public benefit. PABs allow for the private sector to borrow at tax-exempt rates resulting in lower overall financing costs. Currently any PABs issued for high-speed trains would be subject to a volume cap of the respective state; however, a new category of exempt facilities was created under SAFETEA-LU that allows projects receiving Title 23, and under certain conditions Title 49 funds, to qualify for the $15 billion in transportation PABs. The Secretary of Transportation and the US DOT are responsible for the allocation of these PABs.

PABs are highly attractive to private investors in conjunction with a public-private partnership (P3) program that includes equity investment, design-build, and operations involvement and could be used in conjunction with TIFIA/RRIF. For instance PABs were recently used in the financing of the $1.9 billion Capital Beltway project in Northern Virginia, one of the first variable toll rate congestion pricing projects in the U.S.

6.4 Regional Transportation Authorities

Formerly known as Rural Transportation Authorities, the state legislature broadened the rural authority to regional or a statewide authority in 2005. Prior to the passage of this legislation, every area of the state except the Denver Metro area was allowed to form Regional Transportation Authorities. Currently, a Regional Transportation Authority allows two or more jurisdictions, including the Denver Metro area, to form a taxing authority in order to fund local transportation projects. An Intergovernmental Agreement between the Regional Transportation Authorities and CDOT is required prior to taking it to a vote of the people of the region in order to form and fund a transportation project on the state highway system.

Per CRS 43-4-605, Regional Transportation Authorities have the following means to obtain revenue:

- Impose an annual motor vehicle registration fee up to $10 (for persons residing within authority boundaries).
- Portion of visitor benefit tax (collected within authority boundaries).
- Sales and use tax.
- Mill levy authority (up to 5 mills) on all taxable property (this measure expires in 2019).
- Currently there are four Regional Transportation Authorities statewide, including: Baptist Road Rural Transportation Authority, Gunnison Rural Transportation Authority, Pikes Peak Rural Transportation Authority and the Roaring Fork Rural Transportation Authority.

6.5 Public – Private Partnerships

The Colorado General Assembly gave CDOT the authority to become involved in Public Private Partnerships. Public Private Partnerships are joint partnerships that can be formed between a private entity and CDOT to implement transportation projects funded mostly by private dollars. These are usually structured as "Concessions" involving a Concessionaire supported by financial, design-build, equipment and operations and maintenance partners. The programs are typically bid for operation of the infrastructure for 20 or more years. Highway projects such as E-470 in Colorado are the most common examples.

6.5.1 Public Private Partnerships in Transit

Although not common in the U.S., transit projects are often procured under a Public-Private Partnership (P3) delivery system in most other parts of the world. There are various structures for P3 projects, some requiring the contractor or concessionaire to perform design/build/operate and maintain (DBOM) services at essentially a fixed cost; others include an element of private financing, usually a combination of debt and equity. Transit projects often do not operate with a profit, unlike highway projects funded by tolling. Thus, the owner, such as CDOT, has to pay the concessionaire a subsidy to make up the operating shortfall to cover both annualized capital, operations, and maintenance costs. This can be done, based on the needs and preferences of the owner, in a number of different ways. Common approaches include:

- Fixed price/payment for the DBOM services (usually has escalation and penalties/deductions on the O&M portion)
- A combination of cash payments during the DB phase less than the actual cost of DB followed by at-risk revenues (fare box, advertising, etc.) plus subsidy payment that also usually has escalation and penalties/deductions
- A combination of cash payments during the DB phase less than the actual cost of DB followed by availability payments made to the concessionaire based on meeting prescribed performance standards.

Implementation of a concession for HSIPR would require some form of secured revenue stream such as federal funding, tolls, sales tax revenue, fare box revenues, or some combination of all of these sources. Private debt and equity could then be provided and retired based on the secured (subject to adequate performance) revenue stream from the owner as part of the monthly availability payment. This allows the public sector to leverage private capital over a 20 to 40 year period.

Another advantage of the Public-Private Partnerships approach is that the private sector efficiencies driven by a profit motive have been found to result in a shortened delivery, often at a reduced cost. Regional Transportation District, for example, realized a reduction in capital costs of as much as $300 million or about 15 percent of the construction value of the Eagle P3 project as compared to their internal estimate.

6.5.2 FasTracks

The $2.2 billion Eagle Public Private Partnership (Eagle P3) project for the Regional Transportation District in Denver is the largest transit project being delivered by a Concessionaire in the U.S. The project is the construction and operation of the East Rail Line, Gold Line, Northwest Electrified Segment (NWES) (segment 1 of the Northwest Rail Line) and Commuter Rail Maintenance Facility project. It requires the Denver Transit Partners (DTP) to design-build-finance-operate-maintain (DBFOM) the various projects. RTD retains ownership of all assets and leases them back to the concessionaire. The concessionaire is designing and building the project. RTD will make availability payments to the concessionaire based on their performance of the operation and maintenance of the project.

This concession includes a 34-year agreement, with the physical infrastructure turned back to the Regional Transportation District at the end of the contract. The $2.2 billion project received a $1.03 billion Full Funding Grant Agreement from the Federal Transit Administration in 2011 and a $280 million TIFIA loan in 2012. RTD is using some Sales Tax bond receipts combined with $487 million of debt and equity arranged by the concessionaire.

6.6 Local Districts or Corridors

Local sources are those funding sources that apply only to limited geographic areas, usually a county, city, or a special district, within either. In effect, the sources below (listed for informational purposes only) could potentially be implemented on a localized scale to fund specific projects or portions of a project witin the jurisdiction from which the dollars were generated. The sources typically require voter approval, constitutional amendments, property owner approval or some combination.

- **Local Tax Increase**. Local taxes could be increased to generate revenue specifically designated for use in the Corridor
- **Special Taxing Districts**. New taxing districts could be created from which the revenue generated could be applied to improvements within a specific part of the HSIPR corridor. Business Improvement Districts and Urban Renewal Districts are common examples.
- **Real Estate Transfer Tax**. For example, a tax on real estate sales along the HSIPR corridor could be implemented from which the revenue generated could be applied to improvements in the Corridor.

