Appendix A
Model and Ranking Results
### Results Summary

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Multi-Modal Circulation</th>
<th>Economic Development</th>
<th>Minimize Impacts</th>
<th>Totals w/o Costs</th>
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<th>Total plus Costs</th>
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TECHNICAL MEMORANDUM

Logan’s Transportation Master Plan shows five concepts for one-way couplets labeled as alternatives A-E. This graphic is taken directly from that plan. The purpose of this study is to evaluate those concepts in greater detail to determine which are most feasible and beneficial to the city’s overall objectives.

Model Preparation
The CMPO model was recalibrated to improve its accuracy for this study area (which also improved its accuracy across the entire county). It was then used to analyze the ability of each scenario to reduce congestion, and also to obtain daily and peak hour volumes. A separate memo was produced detailing this calibration effort. This memo first describes the nuances of each scenario, and then discusses observations of each from the CMPO model.

Alternative Concept Descriptions

Alternative A
Even today when Main Street is gridlocked, many choose to travel 100 and 200 East – especially those whose origin and destination is east of Main (a rapidly increasing number going into the future). But at present these streets cannot handle much additional volume when operated in 2-way configuration. Instead of operating two-way, with 1 lane each direction and a center turn lane, the city could change to operate 2-lanes in 1-direction (with no center lane required), then both streets together could handle significantly more traffic than they can together handle now. Any stop signs in the N-S direction would be eliminated, and signals would be installed where E-W traffic would otherwise be unduly inhibited. Very little construction would be required to implement these. They can maintain their residential character, and few if any trees would be affected. Pavement, shoulder and park-strip upgrades are optional and at the discretion of the city. Speed limits could be raised by 5 mph (helping them attract trips away from Main), or they could remain as they are now, also at the discretion of the city. Either way, average speeds will still be better due to easier signal coordination and because traffic would not be delayed as much at signals.

To residents this concept will probably feel like less traffic. When traffic is flowing heavily in two directions, drivers eventually take unsafe gaps out of frustration. This makes it easier and safer to get out of their driveway because they only need a gap in one direction. Because these streets are only a block apart, out of direction travel would be insignificant. The benefits of circulating more easily and getting in and out of driveways more easily would tend to overshadow the negatives of a block’s worth of out of direction travel.

Bicyclists and pedestrians will also find this preferable to two-way streets. They too only need a gap in one direction to cross a street. To the extent that you already have center turn lanes, these could be eliminated, and
the space used instead for bike lanes or better pedestrian amenities. This also makes it easier to flair sidewalks out further at intersections, reducing the width required for pedestrians to cross. Signal cycle lengths are also typically shorter, reducing the time bicyclists and pedestrians must wait in order to cross.

At the southern transition point, the transportation plan shows that this couplet requires a bridge to be constructed over the river at 200 East, in order to carry northbound traffic. However, the existing bridge at 100 East appears to be wide enough to accommodate two-way traffic using 4 lanes (no center lane required on the deck). Thus the southern transition could use 90-degree angles at 300 South, just as the northern transition must do at 800 North because of the school. The bridge crossing is better and allows for a smoother transition, but it also makes implementation more expensive, which could delay implementation.

This couplet by itself will not solve the long-term problems of Main Street. But it can be a valuable short-term “relief valve” that reduces the stress on Main until a better long-term solution can be funded and implemented for Main. It can also remain in effect after a Main Street solution is implemented, continuing to do its part to maintain livable conditions on Main in perpetuity. It ranks poorly by itself as a long-term solution, but it ranks #1 when combined with Alternative B (forming Alternative E, which is A + B). Because it is low cost, it has high return on investment. It also would allow the public to experience a couplet and see the benefits (including that it eliminates any further discussion of widening 200 East through the heart of the city). If that early experience is positive, that could help generate support for a longer term couplet solution that may directly involve Main Street.

**Alternative B**

The CMPO model suggests that the Main Street corridor will soon need far more capacity than in currently has, but Main itself is already 5-lanes and cannot achieve 7-lanes in critical sections unless parking is eliminated. Even if parking were eliminated, the result would be a massive over-emphasis on autos through the middle of Logan’s most pedestrian-oriented commercial spaces – completely out of context with the Downtown Specific Vision.

Alternative B suggests that instead of today’s 2 lanes each direction on Main, and 1 each direction on 100 West, with center lanes on both (6 lanes + 2 center lanes), that you instead run 3 lanes in just one direction, with no need for center lanes (6 lanes + 0 center lanes). If 3 lanes is efficient enough to solve the problem, then pavement on Main dedicated to autos could be reduced by 2 lanes, and pavement on 100 West would remain largely unchanged except at transitions, where there clearly is not enough room, and as may be required by UDOT in order to meet their shoulder standards. This scenario of necessity requires that UDOT would take ownership of 100 West, or alternatively that Logan would agree to maintain the road at UDOT standards in perpetuity. In this scenario, 100 and 200 East would remain 2-way streets just as they are now.

The CMPO model suggests that 6-lanes in a couplet configuration creates significantly more capacity than today’s 8-lanes in two-way configuration. However it also suggests that future demands could be so high as to require 4-lanes each direction on Main and 100 West by 2040 (8 total) to solve the problem if 100 and 200 East remain as 2-way streets. But even if four northbound lanes were required on Main (one of which could be an HOV lane for BRT, etc.), then Main could still be reduced by 1-lane – making it far more practical to implement bike lanes, outdoor restaurant seating, taco carts, street vendors, wider/better pedestrian amenities – all of the things that help bring the Downtown Vision to life. But in that case 100 West would also need 4 lanes at UDOT standards rather than today’s 3. This would entail new right-of-way acquisition, but most homes and business buildings could remain, because existing setbacks are probably sufficient.

The northern transition point will most likely occur somewhere between 750 North and 1100 North. North of that point, Main Street would need to be widened to 7-lanes at least to 1500 North. This eventually needs to happen regardless, and the widening to 7-lanes is shown on the CMPO plan. 7-lanes in two-way operation will be quite inefficient because of the left turn arrows and double-left pockets required on all approaches at 1400 North. So it would also help to install an Innovative Intersection concept at 1400 North, and potentially at other locations, such as a Continuous Flow Intersection, a Quadrant Intersection, or a Thru-Turn Intersection. At first glance, all of these look like they could be implemented at 1400 North and Main. For more
The southern transition requires an extension of 100 West, which is already planned, but may need to be altered to meet UDOT design standards for width and bridge design if this alternative is selected. It would also be useful to run a connection from 100 West southeast to the “Y” intersection, so that southbound traffic can make its way over to Hwy 165 through Nibley (i.e., Main). That connection is not entirely necessary, as this movement could also be served by routing southbound traffic across Hwy 89/91 via 100 West, then reconnecting to Main at 1200 South, or also perhaps by simply continuing the couplet through Nibley on the same 100 West alignment, which from aerial photos appears to still be possible. Nibley may well prefer to first see how it goes in Logan before committing to a couplet themselves, but they would still be wise to create the 100 or 150 West alignment anyway and operate it as a two-way street in the meantime. Major corridors benefit greatly from such “backage roads” anyway, and they easily have the option to convert at any time. Perhaps CMPO could take initiative to work with Nibley to get a 100/150 West alignment shown on the CMPO plan.

Out of direction travel for autos is insignificant, because at all locations the Main/100 West couplet is separated by only one block. Time saved due to less congested circulation, and easier ability to get a gap in one direction rather than both, more than makes up for time lost due to a block of out of direction travel. And if your destination is between Main and 100 West, there is zero additional travel. For transit patrons, it is nice if the place they come back to is the same place they got off, so this couplet has that negative. But a block of extra walking may be overshadowed by positives such as the ability for transit to operate in an HOV lane or on dedicated right-of-way, and also by the ability to achieve the Downtown Vision, which creates new transit oriented development in Downtown.

A couplet that results in more traffic on 100 West, and a general upgrade of 100 West as a Complete Street, will also make it attractive to expand businesses and condominium projects over to that street, and on the cross streets between, resulting in a true walkable mixed-use Activity Center, rather than just a single popular street.

**Alternative C**

In this concept, 100 East would operate as northbound one-way, and 100 West would be southbound one-way. Main Street could then remain exactly as it is now, or it could be converted into a pedestrian mall, perhaps with a transit mall shuttle, and vehicle access to angle parking on Main. If Main remains as it is now, then no UDOT action is required, as Logan can easily implement this couplet to serve as a relief valve for Main. When modeled, this concept does little to reduce congestion on Main, because Main must first be failing before anyone is motivated to use the couplet. The couplet would have 2-blocks between northbound and southbound, and there are significant transition costs and problems also, so the local implementation of this concept was eliminated from further consideration.

In the concept where Main becomes a pedestrian mall with BRT and/or parking access, then UDOT action would be required, as both 100 East and 100 West would have to be upgraded to meet UDOT design standards since the state highway would be diverted to those alignments. UDOT standards would require smooth, diagonal transitions, creating significant impacts to properties at both the north and south transition points, and also to many properties in between. The couplet would be at least 3-lanes each direction. If 4 were required, impacts especially on 100 East would be very significant. Another negative about this couplet is that the use of 100 East for northbound flow eliminates the possibility of capacity to be gained by implementing Alternative A. But diverting traffic to 3-lanes northbound on 100 East, and 3-lanes southbound on 100 West, does handle traffic about as well as Alternative B when it has a similar 3-lanes.

The virtue of this alternative is that it is the only strategy available for converting Main into a pedestrian mall – a concept that is very compatible with the Downtown Plan. For that reason, it may be worth a detailed look as part of an environmental impact study, so that businesses and the general public can decide for themselves if the positives of a pedestrian mall outweigh the significant negatives. But given the other alternatives, a pedestrian mall is not necessary for Main to be far more pedestrian friendly.
Alternative D

D is identical to B, except at the northern transition. B transitions back to Main between 750 and 1100 North, while D transitions from 100 West to 200 West between 650 and 850 North. It then continues on 200 West until at least 1600 North, where it transitions northeast diagonally to connect back to Main at about 1750 North. Alternatively, aerial photos show that it could easily transition back to 100 West at that point, and continue on as far northward as desired. Where Alternative B requires Main to be widened to 7-lanes between the northern transition point and 1500 North, Alternative D allows Main to be narrowed from the existing 5-lanes to just 3 or 4 lanes, making Main much more pedestrian friendly in that section. However, this northern portion of Main has much more auto-oriented uses than the downtown. If opening day traffic volumes drop below today’s levels, these auto-oriented convenience businesses may initially be affected, even if volumes are expected to recover to the same levels by 2040.

Alternative E

This alternative is quite simply A + B, the collector-grade couplet on 100/200 East, combined with the UDOT couplet that uses Main and 100 West. It could also be implemented as A + D, but was evaluated here as A + B. The UDOT couplet by itself (B) performs very well, but it would probably need to have 4 lanes on each street. When the 100/200 East couplet is also implemented, it is a lot more practical for the UDOT couplet to have just 3 lanes on each alignment. Alternative E is extremely attractive regardless of whether Main/100 West each have 3 or 4 lanes. 3 lanes makes it possible to reclaim 2 lanes of Main Street pavement for other uses, and it also helps reduce the impacts of upgrading 100 West to UDOT standards. 4 lanes, combined with couplet A, creates more overall capacity than any other alternative, helping ensure that downtown circulation is easy and congestion free for a very long time.

Two 2-Way Arterials

Besides couplets, it is also possible to create additional capacity in the Main Street corridor by widening 100 West into a 5-lane arterial, rather than widening Main itself into a 7-lane arterial. In that case, 100 West and Main would be virtually identical, with each as 5-lane two-way arterials. This scenario does not necessarily require UDOT to take ownership of 100 West, though it may still be possible to convince UDOT and the legislature to upgrade 100 West with state funds and take ownership of it because it helps the state solve their problem of excessive congestion on the state highway. Where the couplets require a northern transition back to Main, so that southbound traffic can transition from Main to 100 West, this alternative does not need this transition. However, because this study attempts to solve problems clear to 1400 North, this concept requires widening 200 West to 5 lanes starting at about 1500 North, then the 5-lane arterial would transition to 100 West starting at about 850 North and ending by 650 North. But even without the transition back to Main, this concept would require far more property acquisition than a 4-lane southbound couplet on 100 West, because it requires 5-lanes, one of which is a center median. It also would not have as much capacity as the couplets. At first glance it seems like it should have more capacity. It would have 10 lanes total, where the couplets would have just 8 lanes at the most. However 2 of those lanes are center medians which offer virtually no capacity, and the remaining 8 lanes have less capacity per lane, because one-way couplets are more efficient. The net effect is more pavement, but less capacity than the couplets. But it does allow the status quo on Main to continue, to the extent that there may be fear of change, and it would eliminate the potential to go the wrong way.

Model Results

The CMPO model was used to evaluate the alternatives in terms of traffic performance. Several measures of effectiveness were studied, including how many minutes it takes to travel from 1400 North to the Y in each alternative, percent increase in delay relative to free flow, screenline volumes vs. screenline capacity, the volume/capacity ratio of the of the single busiest road in the PM peak direction of flow, and the total volume expected on Main Street itself. Results are shown in the graphics of this section.
In uncongested conditions, it should take about 7.5 minutes to travel from 1400 North to the Y via Main Street (including stops at signals), and the model estimates it took about 11 minutes in 2010 at congested times. For each alternative, the time required in 2020 and 2040 is shown. Notice that in 2040 it takes twice as long to make the trip relative to 2010's 11 minutes. But many couplet concepts can restore operations to 2010 conditions.
Similar to the previous charts, this shows the increase in delay relative to free flow conditions. Thus in 2010, a peak hour trip would take 43% longer than a free flow trip. By 2020 it will take 86% longer, and by 2040 the same trip will take 193% longer, or nearly three times longer than free flow. Many of the couplet concepts are able to virtually eliminate delay for 2020, and 2040 delay is at worst similar to 2010’s delay.
Each alternative increases the sum of capacity on the four streets in question (green), but it also increases the sum of the volumes on the four streets as well. This is because latent demand that is otherwise traveling through neighborhoods outside these four streets is then attracted back into the corridor where it preferred to be all along. When the 2-direction volume is very near or exceeds the 2-direction capacity, it means that the peak direction streets are certainly failing. The more excess capacity there is, the less congestion there is. In 2010, the four streets together carried about 64,000 vehicles per day. Bangerter Highway in Salt Lake County was also about that much. By 2040 that volume would rise to 96,000 per day in Alt. E – roughly equivalent to a small freeway with 3-lanes each direction. Thus couplets allow the corridor to function as “Cache’s freeway,” as UDOT has described, but it does so in slower, context sensitive fashion.
This shows the Volume / Capacity ratios on the busiest road in the PM peak direction. Currently that is Main Street southbound south of 200 North, but it shift over to 100 West southbound in couplet concepts where the southbound movement has been relocated to 100 West. Note that by 2020 the default RTP situation becomes worse than 2010, but all of the couplet concepts are able to reduce congestion back to no worse than 2010. By 2040, a number of alternatives may still be functioning a little better than 2010.
There have been concerns that some alternatives could reduce volume on Main by as much as half, potentially affecting businesses that rely on visibility from auto patrons. These charts show the expected volume changes on Main itself as a result of the alternative. In every case, volumes drop to no less than the low 30's in 2020 compared to the high 30's today. This is because while southbound movements are moved from Main to 100 West, northbound movements are moved from 100 West to Main. In addition, because it is possible to carry more, latent demand that is spilling over to neighborhoods by 2020 is able to come back to Main. So Main Street volumes always remain at a healthy level for business. By 2040, most scenarios show volumes once again approaching levels experienced in 2010. The only exception is Alternative C, where traffic is intentionally diverted completely away from Main. In this case, businesses would be trusting that excellent auto accessibility at their back door, combined with a premium pedestrian and parking experience at the front door, will ultimately be better for business than high auto volumes at the front door.
Summary of Ranking Criteria and Results

CMPO model results were an important factor in helping determine the best concepts to carry forward, but there are also many other factors as well. The steering committee for this effort utilized a spreadsheet to help account for various factors important to the community, and to place a relative importance on each factor. The table below shows how each alternative compared with the others in each major category. Observations from each category are discussed next.

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Improve Multi-Modal Circulation and Mobility

Any option which leaves Main Street as a 5-lane arterial ranks near the bottom because congestion remains excessive, which negatively impacts all other modes as well. In general, 4-lane couplet options fare better than 3-lane options, simply because there are more lanes to help assure that congestion will not be a problem. Also two couplets reduce congestion better than one, so Alternative E is the best performer here because it reduces congestion better than any other option. Alternative E also fared well with multi-modal circulation and Emergency Service response times, because both the major and minor couplets are separated by only one block. Hence transit patrons are not unduly affected, and any minor out-of-direction travel for emergency services and local circulation is more than made up for by time savings due to less congestion and better gaps.

Foster Positive Land Use Change and Economic Development

Major two-way arterials require more lanes to manage the same traffic, and they also require center-turn lanes to help manage traffic. So their footprint is very large, which leaves little room for any Complete Street uses, and makes them most compatible with auto-oriented businesses rather than higher density mixed-use environments. Given that the historic downtown is already pedestrian-oriented, and most of the rest of the auto-oriented Main Street outside of Downtown is ripening for redevelopment and higher densities, it makes sense that options involving 5-lane auto-oriented arterials do not fare well in terms of fostering land use intensification and mixed uses. Alternative C, which reroutes traffic around Main, and the Alternative E options, which employ two couplets, both were ranked highest here, and are each addressed in detail.

Alternative C: This concept may be the best able to foster the most land use change, because it reroutes all through traffic around Main, leaving Main itself to re-emerge as it once was generations ago, with angle parking, trees, streetscape, etc. Perhaps this is why it is shown in the Downtown Plan as the preferred concept. The rerouting of traffic most likely would require the removal of several homes and businesses, seemingly more on 100 East than on 100 West, but several nonetheless. That is a major negative accounted for elsewhere, but also potentially positive for land use change and economic development in that it removes many less compatible uses and opens parcel remnants for more compatible uses.

Because of its impacts, Alternative C overall is not one of the top three concepts overall, but it is not far behind and could emerge in first place eventually depending on the community’s interests and the development of a program that successfully addresses the negatives. The rerouting of traffic, and subsequent reinvention of Main is a radical change but not necessarily a bad change. It would clearly hurt businesses such as gas stations on Main. They’d still be accessible via Main and cross streets, but they would no longer have any significant amount of traffic passing by. But, the reinvention of Main could easily elevate the value of those parcels,
making it attractive to sell to more compatible higher density uses. They could then move elsewhere, perhaps a block over to where auto traffic has been rerouted.

This concept has high potential, but also comes with serious consequences. If the potential is ever to have a serious chance of emerging, then a program will have to be carefully crafted and could include a market analysis of the potential value of land after the change, perhaps a redevelopment area declaration that will enable you to acquire businesses and other properties that will be seriously affected. Perhaps the project itself could set up a revolving fund to purchase properties from anyone who would not want to remain, and then pay back the fund once those properties are resold for more compatible uses. Animations, artistic renderings, market analysis, and program details would need to exist before public opinion solidifies against the idea, as they may tend to focus on the obvious negatives unless those negatives have been addressed adequately in advance.

**Alternative E:** The 3-lane concept means there would be three traffic lanes on Main and 100 West, but just 2 on 100 East and 200 East. The 4-lane concept raises Main / 100 West to 4 lanes, but still leaves 100/200 East as 2-lanes each. With Main at just 3-lanes, existing pavement can be converted to Complete Street uses, which will make it attractive to redevelop existing auto-oriented uses into higher-density mixed uses. Also, the upgrade of 100 West will likewise encourage the expansion of Downtown to that street. The overall ability of the four streets combined to handle a lot more multimodal traffic trips will likewise help ensure that development that otherwise would have went to suburban locations will instead find it attractive to locate in the historic core. Many of the other couplet concepts do this as well, but E is the most pronounced. Most of the others also require 4-lanes on Main/100 West to operate well, but E operates well-enough on just 3-lanes, because the other couplet is able to carry any spillover. E is a good compromise between the RTP, with its serious problems on Main, and Alternative C, which routes all traffic away from Main. E maintains enough volume on Main for the auto visibility that existing businesses may be dependent on, but also opens opportunities on Main for it to emerge as an attractive Complete Street corridor. A more detailed study with microsimulation analysis should determine if 3 or 4 lanes are ultimately needed on Main, but either way this may be the best bridge to move from today’s reality to tomorrow’s vision.

**Minimize Neighborhood and Environmental Impacts**
It almost goes without saying that since the RTP and smaller locally-implemented couplet concepts require very little effort to implement, they also score very well in terms of their ability to minimize impacts. But they also fail to adequately address the significant impact of congestion on Cache’s livability and economy. Outside of these minimalist strategies, Alternative E 3-lanes scores well in this category, primarily because it fits well within existing right-of-way, but also because in many places it will need less pavement than is already there, which positively affects neighborhoods and helps most places become more walkable.

**Minimize Overall Cost of Implementation**
Minimizing costs also tends to minimize the effectiveness of the alternative at solving the congestion problem. So not unexpectedly the default RTP, and the locally implemented couplets score highest here. But as discussed earlier, while Alternative A does relatively little to solve long-term congestion, it also doesn’t cost much to implement, so it has a high return on investment. The more effective options regarding long-term congestion are also expected to be among the most expensive options. Even those that can largely stay within the existing right-of-way may still need pavement and utility reconstruction, and ideally there would be a considerable effort aimed at beautification and upgraded multimodal amenities.

**Overall Ranking of Alternatives**
Given the criteria and weighting selected by the steering committee, along with both the quantitative and qualitative assessment of each alternative relative to each criteria, a comprehensive score was given to each alternative, which is visible in the above table and also shown graphically for each alternative in the figure below. Alternatives E 3-lane and E 4-lane were rated first and second respectively. The B alternatives, which are sub-elements of the E alternatives, are rated third and fourth. Alternative C, which routes traffic around Main, has great potential to be the best overall driver of economic development, but it also has significant impacts that push it to 5th place overall.
Citywide Effects of Alternative E

When streets like Main Street become overloaded, many drivers divert to parallel streets, which in turn overloads those streets, and causes spill over to roads even further away. The net effect on Logan is that as Main Street congestion gets worse, there will be a lot more traffic on neighborhood streets and collectors, often more than a mile away from Main Street. Any proposal that reduces delay on Main and increases overall capacity in the Main Street corridor will tend to pull that “latent demand” back into the Main Street corridor. That is a good thing for collectors of residential character such as 600 East and 600 West.

The figures on the next pages show the PM peak hour volumes of the currently preferred couplet strategy, Alternative E, compared to the CMPO RTP scenario for the 2040 time period. Green means Alt E causes volumes and congestion to go down on those streets significantly. Red means volumes go up, but congestion usually goes down – hence the reason more traffic was attracted to those corridors. Each half of the road is shown independently. Alternative E employs four streets in a couplet configuration. Notice that on those streets, one half of the road is red, and the other is grey. The grey means that direction carries zero traffic, while the other direction often carries double what it did before, because it has more lanes in that direction. So there is not necessarily much more overall traffic on those streets, but in the couplet direction there is much more, and the effect is to appear like there is much more in this figure.

Both figures are the same, but the second is zoomed in to show the labels more clearly, and the first lets you see the big picture effect on all of Logan. Labels represent daily volume in thousands. The label nearest the link is the RTP volume, and the next is the couplet volume. Looking at the big picture, the couplets generally increase traffic volumes within the corridor, and reduce traffic in all the rest of Logan. Both green and red appear to be desirable. Green because it draws down traffic in areas where the city wants it down, and red because higher volumes and better accessibility help support additional infill and positive redevelopment.
Daily volume changes, post 2040, Couplet E vs. RTP
Red = more traffic, Green = less.
Near label = DY volume in thousands, RTP; Far = Couplet E
Daily volume changes, post 2040, Couplet E vs. RTP

Red = more traffic, Green = less.
Near label = DY volume in thousands, RTP; Far = Couplet E