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TECHNICAL MEMORANDUM

Balboa Reservoir Supplemental EIR

Responses to Comments Supplementary Memorandum

Transit Delay Analysis and Capital Improvements

Date: March 29, 2020~~March 29, 2020~~~~March 29, 2020~~~~March 26, 2020~~
To: Wade Wietgrefe, Liz White
From: Mike Alston
cc: Jeanie Poling

PURPOSE OF MEMORANDUM

This technical memorandum (memo) identifies and analyzes existing sources of transit delay to the 29

Sunset, K/T Third/Ingleside, and 43 Masonic Muni lines in the Balboa Reservoir project study area, and then recommends offsite capital improvements to reduce transit travel times. The results of this analysis further refine and inform Balboa Reservoir Draft Subsequent Environmental Impact Report (DSEIR)'s **Mitigation Measure M-C-TR-4. Monitor Cumulative Transit Travel Times and Implement Measures To Reduce Transit Delay**.

This memo is organized as follows:

- Background
- Analysis Approach
- Findings
- Recommended Improvements
- Secondary Effects of Implementing Improvements

BACKGROUND

The DSEIR presented an analysis of transit delay under existing plus project conditions and under 2040 cumulative conditions. The impacts were determined to be less than significant under existing plus project conditions and significant and unavoidable under 2040 cumulative conditions, with the proposed project contributing considerably. The project would make a considerable contribution[1,2],

[1] ~~The 8 Bayshore and 8BX Bayshore B Express series buses also travel through the study area; however, as identified in the DSEIR, the proposed project would not considerably contribute to cumulative transit delay on these routes. The 91~~

Commented [w1]: Great job! The document provides substantial evidence for the revisions to mitigation measure M-C-TR-4. Monitoring Cumulative Transit Travel Times and Implement Measures to Reduce Transit Delay. Most of our edits and comments are editorial to clarify language and to shorten this memo up. Please reach out to Liz to clarify comments and edits.

Few globals:
-address the 43.
-Liz attempted to delete 49 references, but double-check.
-please avoid terms that may be misconstrued as CEQA impact determinations (e.g., substantial).
-please use consistent terms as that used in the EIR and then if new terms here, use consistent terms throughout.
- Instead of infrastructure, let's call them capital improvements.
- Several parts of the analysis keep referring to cumulative delay. Please keep it as delay. Under +project conditions, our mark is 4 minutes, under +cumulative conditions, our mark is 2 minutes. The point is that we are trying to erase the project's delay before it begins, cumulative and project conditions.
-some minor other stylistic items

Commented [HT2]: Global On our website, it is stylized as: KT: K Ingleside/T Third Street.

LWhite: Kittelson, please make this a global.

Commented [w3R2]: Unless the draft SEIR said something else, then fine to leave as is.

Commented [MGA4R2]: The draft SEIR used K/T Third/Ingleside. Keeping consistent with that document.

defined as two or more minutes, to cumulative transit delay to the K/T Third/Ingleside; 29 Sunset; and the 43 Masonic Muni lines.[3,4]

ANALYSIS APPROACH

This analysis consists of both quantitative and qualitative approaches to identify and analyze sources of transit delay and quantify how implementation of capital improvements would reduce transit travel times. Figure 1~~Figure 1~~ presents the study area as it relates to these approaches.

Analysis Approach for K/T Third/Ingleside and 29 Sunset

The analysis approach compares transit travel times during the peak period and nighttime off-peak period. Transit travel times are typically slowest during the p.m. peak period, greatly influenced by vehicle congestion. Off-peak nighttime travel times represent conditions in which transit vehicles do not experience the typical delays related to vehicle congestion in the p.m. peak period. As a result, the off-peak nighttime travel times are a comparison to the p.m. peak period travel times to calculate the differences between individual segments of delay within the study area, and to identify the delay sources for those segments.

Identifying the specific locations, causes, and amount of delay along a transit route provides the ability to estimate delay reductions from capital improvements. In contrast, the data collected for the DSEIR analysis includes existing K/T travel times for the full segment along Ocean Avenue between Jules Avenue and Balboa Park BART, but not for points and subdivided segments along the corridor.

The analysis was conducted for the routes along the following segments:

- K/T Third/Ingleside: Jules Avenue/Ocean Avenue to Balboa Park Bay Area Rapid Transit (BART);
- K/T Third/Ingleside: San Jose Avenue/Geneva Avenue to Dorado Terrace/Ocean Avenue;

~~Third Street/19th Avenue Owl and K Owl also travels through the corridor but is an overnight only route and is not included in the analysis.~~

~~[3] The Responses to Comments (RTC) document revised the draft SEIR analysis and Mitigation Measure M-C-TR-4, which incorrectly identified that the proposed project would have a considerable contribution to cumulative transit delay on the 49 Van Ness/Mission line.~~

[3] The 8 Bayshore and 8BX Bayshore B Express series buses also travel through the study area; however, as identified in the DSEIR, the proposed project would not considerably contribute to cumulative transit delay on these routes. The 91 Third Street/19th Avenue Owl and K Owl also travels through the corridor but is an overnight only route and is not included in the analysis.

[4] The Responses to Comments (RTC) document revised the draft SEIR analysis and Mitigation Measure M-C-TR-4, which incorrectly identified that the proposed project would have a considerable contribution to cumulative transit delay on the 49 Van Ness/Mission line.

- 29 Sunset: Plymouth Avenue/Ocean Avenue to Mission St/Persia Avenue; and
- 29 Sunset: Mission St/Persia Avenue to Plymouth Avenue/Ocean Avenue.

Figure 1: ~~Memo Approaches~~ Transit Delay Analysis and Capital Improvements Study Area

Commented [w5]: Please use draft SEIR figure 3.B-3 as your base and update the figure accordingly to articulate the items you are attempting to highlight. Please provide a symbol in the legend for new items in this figure.

Please rethink boundary of memo approach study area to reflect what is described in this memo and to track the streets more closely (e.g., instead of going into Westwood Park).

Commented [MGA6R5]: Updated with a study area illustrated to match the discussion here (including the secondary effects we're considering)

Field data collection was collected to identify the following:

- Sources of transit delay along the corridor (location and descriptive cause);
- Delay values associated with given locations and bus actions (corridor delay, transit reentry delay, or passenger boarding delay); and
- Qualitative observations of conditions at potential improvement locations.

Based on the data and observations, capital improvements are then recommended to improve transit operations at a fixed point along a service segment (i.e., an intersection and approach direction), with benefits accruing to the segment's travel time.

~~The analysis approach compares transit travel times during the peak period and nighttime off-peak period. Transit travel times are typically slowest during the p.m. peak period, greatly influenced by vehicle congestion. Off-peak nighttime travel times represent the conditions in which transit vehicles do not experience the typical delays related to vehicle congestion in the p.m. peak period. As a result, the off-peak nighttime travel times are a comparison to the p.m. peak period travel times to calculate the differences between individual segments of delay within the study area, and to identify the delay sources for those segments.~~

~~Identifying the specific locations, causes, and amount of delay along a transit route provide the ability to estimate delay reductions from improvements. In contrast, the data collected for the DSEIR analysis includes existing K/T travel times for the full segment along Ocean Avenue between Jules Avenue and Balboa Park BART, but not for points and subdivided segments along the corridor.~~

~~The The analysis was conducted for the routes along the following segments:~~

~~K/T Third/Ingleside:, Jules Avenue/Ocean Avenue to Balboa Park Bay Area Rapid Transit (BART);~~

~~K/T Third/Ingleside:, San Jose Avenue/Geneva Avenue to Dorado Terrace/Ocean Avenue;~~

~~29 Sunset:, Plymouth Avenue/Ocean Avenue to Mission St/Persia Avenue; and~~

~~29 Sunset:, Mission St/Persia Avenue to Plymouth Avenue/Ocean Avenue;~~

~~49 Van Ness/Mission, Frida Kahlo Way/CCSF South Entrance to Mission St/Persia Avenue; and~~

~~49 Van Ness/Mission, Mission St/Ocean Avenue to Frida Kahlo Way/CCSF South Entrance.~~

~~Field data collection was conducted to identified y the following:~~

~~Sources of transit delay along the corridor (i.e., location and descriptive cause);~~

~~Delay values associated with given locations and bus actions (corridor delay, transit reentry delay, or passenger boarding delay); and~~

~~Qualitative observations of conditions at potential improvement locations.~~

~~Based on the data and observations, caCapital improvements are then recommended to would be targeted to improve transit operations at a fixed point along a service segment (i.e., an intersection and approach direction), with benefits accruing to the segment's travel time.~~

Analysis Approach for 43 Masonic

The analysis for the 43 Masonic supplements the Synchro corridor analysis from the DSEIR and utilizes the traffic counts and future traffic volumes from the DSEIR to calculate delay to the line at the Ocean Avenue/Frida Kahlo Way/Geneva Avenue intersection.[5] The delay associated with the inbound 43 Masonic (i.e., going towards Balboa Park BART station) primarily comes from the signal at Frida Kahlo Way/Geneva Avenue/Ocean Avenue. The delay experienced at this intersection is primarily associated with vehicle congestion. This is different than the delay on Ocean Avenue, which can be attributed to other factors, such as left or right turning vehicles.

Commented [EW7]: Kittelson, I know we worked on this addition together but just realized this is the first time this is introduced in the memo so please define this in a footnote.

Commented [MGA8R7]: We have included a footnote description here.

As a result, no additional data collection was needed to calculate transit delay because the supplemental Synchro analysis allows the disaggregation of corridor travel time to identify the amount of delay attributable to the specific transit movement at the intersection versus along the segment as a whole.

DATA COLLECTION

The field data collection occurred in two phases to achieve a disaggregate analysis of travel times and delays. The p.m. peak period data collection and observations yielded travel times along and through fixed segments of the transit routes, along with descriptions of operational events at each location. The p.m. peak period data collection was conducted from 5-7 p.m. on Tuesday, December 17, 2019; Wednesday, December 18, 2019; and Thursday, January 16, 2020. The off-peak travel time runs provided a baseline travel time along the lines as well as times along and through the same fixed

[5] As part of the DSEIR analysis, transit corridor delay was quantified using Trafficware's Synchro modeling software arterial/corridor delay reports to calculate traffic congestion delays along corridors served by transit. Intersection operations analysis was performed using Synchro software and conducted using the SF Planning Department's *Guidelines for Synchro Intersection LOS Analysis*. Intersection operations were analyzed for Existing Conditions, Existing plus Developer's Proposed Option (which includes reassigned parking trips), and Existing plus Additional Housing Option (does not include reassigned parking trips) for the weekday a.m. and p.m. peak hours.

segments observed in the p.m. peak period collection. The off-peak travel time runs occurred between 8 p.m. and 11:59 p.m. on Thursday, January 9, 2020, and Thursday, January 23, 2020.[6,7]

P.M. Peak Period Delay Collection and Observation

Travel time data were collected and qualitative observations recorded at the following locations from a fixed vantage point[8]:

- Ocean Avenue and Brighton Avenue (eastbound and westbound)[9];
- Ocean Avenue and Plymouth Avenue (eastbound and westbound)[97]; and
- Ocean Avenue and Frida Kahlo Avenue (eastbound and westbound)[10].

At each intersection, both segment travel time and ~~node~~intersection travel time were calculated, both of which are defined below. The number of observations used to establish the averages is provided in each table with the discussion of findings.

Segment travel time is defined as the time required for the transit vehicle to travel from the previous intersection to the subject intersection. The recorded time began when the front of the vehicle cleared the previous intersection and ended when:

- The vehicle stopped at a red light or entered the back of a queue at the light; or
- The front of the vehicle entered the intersection during a green light; or
- The vehicle was within a car length of the back of a queue at the intersection.

~~Node~~Intersection travel time is defined as the time required for the transit vehicle to pass through an intersection. ~~.~~

The recorded time began when:

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[6] City College was in regular session during all p.m. peak period data collection (December 17, December 18, January 16). City College was in regular session during January 23, 2020, off-peak (8-11 p.m.) data collection but not during January 9 off-peak data collection. As explained, off-peak travel time runs were compared to historical data to check that they were representative.

[7] Field data were collected during typical conditions (i.e., no events, disruptions, or inclement weather).

[8] These data collection locations were identified in coordination with the SFMTA.

[9] This intersection was observed from public space in front of the McDonald's on the south side of Ocean Avenue between Plymouth and Brighton avenues.

[10] This intersection was observed from an elevated vantage point on the Ocean Avenue pedestrian bridge.

Commented [EW9]: I have the following questions on this section:
- With the exception of the days, aren't the methods for collection and observation the same under the p.m. peak period and also during the nighttime runs? Should we group them both in the same heading?
- How many observations comprise the p.m. peak period v. the nighttime runs? We should disclose the number of data sets that we averaged to get the nighttime v. peak period data?

Commented [MGA10R9]: 1) The methods for collection are different:
- PM is from a fixed vantage point
- Nighttime (off-peak) is riding the bus

The goal is to measure the same time points under different scenarios, but the PM also provides qualitative descriptions.

Provided an additional sentence above to distinguish...I still think they merit their own sections.

2) We have included the number of observations as a footnote for each table.

Commented [EW11]: Define the vantage points in the footnotes or reference where the reader can find them in the memo.

Commented [MGA12R11]: We have included footnotes describing the vantage points.

- The vehicle stopped at a red light or entered the back of a queue at the light; or
- The front of the vehicle entered the intersection during a green light; or
- ~~The vehicle was within a car length of the back of a queue at the intersection.~~
- ~~The~~ recorded time ended when the front of the transit vehicle cleared the intersection.
- ~~———~~

Off-Peak Travel Nighttime Time Runs

Kittelson conducted onboard travel time runs ~~four observations o~~fn the studied segments to establish baseline times in calculating p.m. peak period delay.~~and compared these average corridor travel times to SFMTA historical travel times. The comparison of the observed data to the historical travel times served as a cross check to ensure that the observations appropriately represented the studied segments.~~[11] These segments included:

- K/T Third/Ingleside ~~K/T Third/Ingleside~~
  - Eastbound, Ocean Avenue/Miramar Avenue to Balboa Park BART
  - Westbound, Balboa Park BART to Ocean Avenue/Miramar Avenue
- 29 Sunset
  - Eastbound, Plymouth Avenue/Ocean Avenue to Ocean Avenue/Howth Street
  - Westbound, Ocean Avenue/I-280 onramp to Plymouth Avenue/ Ocean Avenue

FINDINGS

Ocean Avenue/Brighton Avenue

Eastbound

Table 1~~Table 1~~ provides average observed travel times at Ocean and Brighton avenues in the eastbound direction for the K/T Third/Ingleside ~~K/T Third/Ingleside~~ and the 29 Sunset.

[11] To ensure these travel times were representative of typical off-peak nighttime conditions, Kittelson compared the stop-to-stop travel times to historical SFMTA travel time data as a cross-check. The SFMTA maintains an internal database of historical travel times; those data points are ~~limited~~ aggregated ~~to~~ as historical travel time between stops. SFMTA provided historical weeknight travel times as a point of reference. The SFMTA data provided includes median and 90th percentile historical travel times between stops. The historical travel time data is included in Appendix D. ~~The average off-peak travel time runs for the selected segments were compared against the median historical travel times to ensure they were representative.~~

Commented [HT13]: Don't understand this one so much and how it differs from the first bullet. Does the first bullet only apply when the transit vehicle is the first one in the queue?

Obviously we're not changing the methodology now, but I think it could be worded more clearly.

LWhite: Kittelson, please clarify.

Commented [MGA14R13]: This was just to distinguish "at the light" from "in the back of the queue"…have consolidated the bullet points.

Commented [EW15]: Maybe we just state here that the observations collected were then compared to SFMTA's historical travel times as a cross check?

Comment from T. Henderson: Maybe a new sub-section that just talks about the comparison to historical data? Right now the topics blend and I had to read several times to understand.

LWhite: Kittelson, please revise. Tony and I had similar comments about this.

Commented [MGA16R15]: Included a footnote rather than a separate section. The footnote is long but improves memo readability.

Commented [HT17]: Clarify that this is the SFMTA provided data below. On first read, it can appear that these were the segments for the off-peak data collection.

Table 1:Transit Travel Time Delays Eastbound at Ocean Avenue/Brighton Avenue

Route/Location	Off-Peak Nighttime Average Travel Time, (sSeconds (number of observations))	Peak Average Travel Time (sSeconds (number of observations))	Difference (in s, seconds)
K/T Third/InglesideK/T Third/Ingleside			
LinkSegment travel time: Plymouth to Brighton	14	14	0
NodeIntersection travel time: through Brighton	4	29	26
29 Sunset			
LinkSegment travel time: Plymouth to Brighton	13	17	4
NodeIntersection travel time: through Brighton	12	28	16

Note: Averages based on four K/T off-peak period observations, three 29 off-peak period observations, 16 peak period K/T observations, and 10 peak period 29 observations.
Source: Kittelson, 2020.

Most differences in delay at this location were associated with the nodeintersection: an average of 26 and 16 seconds for the K/T Third/Ingleside K/T Third/Ingleside and 29 Sunset, respectively. The following observations provide context for peak period travel times at this location in the eastbound direction:

- The segment/link travel times were relatively similar between peak and off-peak periods, indicating that delay is mostly related to signal timing and intersection queueing associated with the intersection rather than conditionqueues along the corridor that would slow the corridor transit along the segmentdown.
- The K/T travels in the center-running track lane and is sometimes delayed by left-turning vehicles. The train was frequently observed to be stuck behind left-turning vehicles, at times resulting in missing a green light and incurring additional delay from the red signal.
- The K/T routinely stopped at red lights in the p.m. peak period. In the off-peak period, the line was not observed to experience any travel time delay due to red lights.
- The 29 has the flexibility to operate in either lane and was generally observed in the right travel lane and does not wait directly behind left-turning vehicles (it must be in the right lane traveling through the intersection to be aligned to serve the next passenger stop). However, one observation noted that queuing from a left-turning vehicle affected both lanes and contributed to delay for the 29.
- The 29 was frequently stopped at red lights during the peak period.

Commented [HT18]: Global – use "intersection" instead of "node"?

LWhite: Agree, please make a global edit.

Commented [w19R18]: I'm ok with node or intersection, if the term is defined earlier and used consistently.

Global: please use consistent terms throughout. For example, this table uses link where earlier the term is segment.

Commented [MGA20R18]: Made global edits: "node" removed throughout and replaced with intersection (more intuitive term)….and "link" replaced with "segment" throughout.

Commented [EW21]: Does this mean the signal timing? If not, what does this mean?

Commented [MGA22R21]: Yes, signal timing and queues. Added clarifying language.

Commented [HT23]: Want to confirm my understanding of the methodology. It sounded like that once the train entered the queue, that it ended their "link" travel time and started their "node" travel time. If that understanding is correct, I don't think we can make this statement based on the information we have. Instead, the queue could be part of the node/intersection delay.

LWhite: Kittelson, please address

Commented [MGA24R23]: OK, text has been revised to clarify. We're saying that queueing is happening at the intersection (as the data bear out)

- With the center-running track lane serving left-turning vehicles, the right lane serves the 29, a majority of through vehicles, and right-turning vehicles. Drivers turning right must yield to pedestrian movements at the parallel crosswalk, delaying through vehicles behind right-turning vehicles.

In the eastbound direction, ~~a substantial~~ much ~~portion~~ of the delay to the ~~KT~~K/T Line and a portion of the delay to the 29 can be attributed to left-turning vehicle delay. This includes frequently waiting behind left-turning vehicles searching for a gap in oncoming traffic.

Westbound

Table 2~~Table 2~~ provides average observed travel times on Ocean Avenue approaching and through Brighton Avenue in the westbound direction for the K/T Third/Ingleside ~~K/T Third/Ingleside~~ and the 29 Sunset.

Table 2:Transit Travel Time Delays Westbound at Ocean Avenue/Brighton Avenue

Route/Location	Off-Peak Nighttime Average Travel Time (seconds)	Peak Average Travel Time (seconds)	Difference in seconds
K/T Third/Ingleside			
~~Link~~Segment travel time: Lee to Brighton	8	~~14~~15	~~6~~7
~~Node~~Intersection travel time: through Brighton	3	~~40~~23	~~37~~20
29 Sunset			
~~Link~~Segment travel time: Lee to Brighton	8	~~17~~19	~~9~~11
~~Node~~Intersection travel time: through Brighton	2	~~25~~32	~~23~~30

Note: Averages based on two K/T off-peak period observations, two 29 off-peak period observations, five peak period K/T observations, and seven peak period 29 observations.
Source: Kittelson, 2020.

Commented [MGA25]: In revisiting the spreadsheet analysis to confirm the number of observations, I noticed that some 29 data points were attributed to the KT. I corrected and updated. Hence, the increase in 29 and decrease in KT.

Most differences in delay were associated with the ~~node~~intersection: an average of ~~37~~ 20 and ~~23~~ 30 seconds for the K/T Third/Ingleside ~~K/T Third/Ingleside~~ and 29 Sunset, respectively. The following observations provide context for the peak period travel times at this location in the westbound direction:

- The segment travel times almost doubled for the ~~KT~~K/T and more than doubled for the 29 but represent small portion of each line's travel time compared to the time through the intersection. The differences indicate that p.m. peak period congestion levels affect operating speed through the corridor in the westbound direction.

- The ~~KT~~K/T travels in the center-running track lane and is sometimes delayed by left-turning vehicles. The train was not observed to be stuck behind left-turning vehicles such that the train would miss a green light and incur additional delay from the red signal, as was observed in the eastbound direction. However, left turns do contribute to approach delay in this direction, and the ~~KT~~K/T was frequently observed to experience delay at red lights in this direction. The p.m. peak hour turning movement counts collected for the project show 122 left-turning vehicles in the p.m. peak hour (see Appendix A); observations indicate that most left-turning drivers must wait until the end of the permissive green phase to turn left.
- The 29 operates in the right travel lane and does not wait directly behind left-turning vehicles. The left-turning delay has less direct influence on 29 operations.
- The 29 was frequently stopped at red lights during the peak period.
- With the center-running track lane serving left-turning vehicles, the right lane serves the 29, and right-turning vehicles, as well as observed to serve the majority of through vehicles. Drivers turning right must yield to pedestrian movements at the parallel crosswalk, potentially delaying through vehicles behind right-turning vehicles.

~~***Ocean Avenue/Brighton Avenue Findings***~~

~~In the eastbound direction and westbound directions in the p.m. peak period, left-turning vehicles share the center-running track lane with the K/T, which must wait for vehicles to turn and clear the intersection to proceed straight. To travel through the intersection in the p.m. peak hour, the K/T experiences 26 seconds of travel time delay in the eastbound direction and 37 seconds of travel time delay in the westbound direction compared to off-peak conditions. In both directions, the left turns are served by permissive phasing, requiring drivers to yield to oncoming traffic and to pedestrians crossing to their left. As a result, these drivers typically wait through the green phase and turn at the end of the phase.~~

~~The 29 does not share the track lane and is less sensitive to the propagation of~~delayed by left-turning ~~delay~~vehicles~~. However, with the center-running track lane effectively serving one or two vehicles per green phase, the far right lane in each direction serves~~ the majority of the vehicles ~~(both the 29 bus, the majority of through vehicles, and right-turning vehicles yielding to crossing pedestrians). The 29 experiences an average of 16 seconds of travel time delay in the eastbound direction and 23 seconds of travel time.~~

~~To travel through the intersection in the p.m. peak hour, the 29 experiences 16 seconds of travel time delay in the eastbound direction and 23 seconds of travel time delay in the westbound direction compared to off-peak nighttime conditions. In the westbound direction, the 29 also experiences nine seconds of travel time between Lee and Brighton avenues, doubling its off-peak travel time.~~

Commented [w26]: Please delete all the findings for each of the intersection sections. It summarizes what's already been said and I would prefer to leave this memo as short as possible. Please let me know if you disagree.

Commented [MGA27R26]: Agreed. This was an attempt to summarize and recap. But the sections are relatively brief anyway.

Ocean Avenue/Plymouth Avenue

Eastbound

Table 3~~Table 3~~ provides average observed travel times at Ocean and Plymouth avenues in the eastbound direction for the K/T Third/Ingleside ~~K/T Third/Ingleside~~.

Table 3:Transit Travel Time Delays Eastbound at Ocean Avenue/Plymouth Avenue

Location	Off-Peak Nighttime Average Travel Time (seconds)	Peak Average Travel Time (seconds)	Difference in seconds
K/T Third/Ingleside~~K/T Third/Ingleside~~			
~~Link~~Segment travel time: Miramar to Plymouth	16	~~-~~*Not recorded*[1]~~1~~	-
~~Node~~Intersection travel time: through Plymouth	13	27	14

[1] ~~O~~Because of limitations from a fixed vantage point, observed p.m. peak period ~~link~~ segment travel time was noted between ~~was for the segment between~~ Granada ~~Avenue and~~ and Plymouth ~~A~~avenues, whereas off-peak period observations noted time between Miramar and Plymouth avenues~~, not from Miramar~~. Comparison of the two entries would ~~would~~ not be commensurate.

Note: Averages based on four ~~KT~~K/T off-peak period observations and seven peak period ~~KT~~K/T observations.

Source: Kittelson, 2020.

Commented [w28]: Table note missing from table and please clarify second sentence.

Commented [MGA29R28]: Updated.

The average p.m. peak hour travel time delay through the intersection was 14 seconds compared to off-peak nighttime conditions. The following observations provide context for peak period travel times:

- The ~~KT~~K/T was observed to sit at a red light in almost all p.m. peak hour observations, including as a result of waiting behind a left-turning vehicle and subsequently missing a green phase. Like at the Brighton location, the ~~KT~~K/T travels in the center-running track lane and is sometimes delayed by left-turning vehicles.
- The 29 turns right from Plymouth Avenue onto Ocean Avenue at this intersection and does not travel eastbound through the intersection.

Westbound

Table 4~~Table 4~~ provides average observed travel times at Ocean and Plymouth avenues in the westbound direction for the K/T Third/Ingleside ~~K/T Third/Ingleside~~ and the 29 Sunset.

Table 4: Transit Travel Time Delays Westbound at Ocean Avenue/Plymouth Avenue

Location	Off-Peak Nighttime Average Travel Time (seconds)	Peak Average Travel Time (seconds)	Difference in seconds

K/T Third/Ingleside~~K/T Third/Ingleside~~			
~~Link~~Segment travel time: Brighton to Plymouth	7	11	4
~~Node~~Intersection travel time: through Plymouth	4	29	25
29 Sunset			
~~Link~~Segment travel time: Brighton to Plymouth	5	9	4
~~Node~~Intersection travel time: through Plymouth	3	33	30

Note: Averages based on two ~~KT~~K/T off-peak period observations, three off-peak period 29 observations, six peak period ~~KT~~K/T observations, and 12 peak period 29 observations.
Source: Kittelson, 2020.

The average p.m. peak hour travel time delay through the intersection was 14 seconds compared to off-peak nighttime conditions. The following observations provide context for peak period travel times:

- The travel time difference in segment~~/link~~ travel times for each line indicates that the sources of delay are at the intersection rather than due to overall travel speeds on the segment.
- The ~~KT~~K/T was observed to sit at a red light in most all p.m. peak hour observations, including as a result of waiting behind a left-turning vehicle and subsequently missing a green phase on multiple occasions. The average delay experienced is largely a result of delay behind left-turning vehicles and subsequent red-light delay. Although the p.m. peak hour average among observations is 30 seconds, the maximum observed intersection travel time was 57 seconds, indicating wide variability. Like at the Brighton location, the ~~KT~~K/T travels in the center-running track lane and is sometimes delayed by left-turning vehicles.
- The 29 turns left onto Plymouth Avenue at this intersection, so it is subject to the same operational delay and issues as the ~~KT~~K/T. During the p.m. peak hour, the 29 was observed to miss its green phase multiple times, with a maximum ~~node~~intersection travel time of 99 seconds resulting from waiting for left-turning drivers (sitting through two red phases).

~~Ocean Avenue/Plymouth Avenue Findings~~

~~In the eastbound direction and westbound directions in the p.m. peak period, left-turning vehicles share the center-running track lane with the K/T, which must wait for vehicles to turn and clear the intersection to proceed straight. To travel through the intersection in the p.m. peak hour, the K/T experiences 14 seconds of travel time delay in the eastbound direction and 25 seconds of travel time delay in the westbound direction compared to off-peak conditions. In both directions, the left turns are served by permissive phasing, requiring drivers to yield to oncoming traffic and to pedestrians crossing to their left. As a result, these drivers typically wait through the green phase and turn at the end of the phase.~~

~~In the eastbound direction the 29 does not travel through the intersection on Ocean Avenue. In the westbound direction the 29 turns left from the center running track lane and is sensitive to thesometimes delayed by propagation of left-turning delayvehicles. The 29 was observed to miss green phases on multiple occasions due to waiting behind left-turning vehicles, including missing two green phases on one occasion. To travel westbound through the intersection in the p.m. peak hour, the 29 experiences an average of 30 seconds of travel time delay compared to during off-peak conditions.~~

Ocean Avenue and Geneva Avenue/Frida Kahlo Way

Eastbound

Table 5~~Table 5~~ provides average observed travel times in the eastbound direction for the K/T Third/Ingleside ~~K/T Third/Ingleside~~ and the 29 Sunset.

Table 5: Transit Travel Time Delays Eastbound at Ocean Avenue/Frida Kahlo Way/Geneva Avenue

Location	Off-Peak Nighttime Average Travel Time (seconds)	Peak Average Travel Time (seconds)	Difference in seconds
K/T Third/Ingleside~~K/T Third/Ingleside~~			
~~Link~~Segment travel time: Lee to Frida Kahlo	19	18	-
~~Node~~Intersection travel time: through Frida Kahlo[1]	39	53	14
29 Sunset			
~~Link~~Segment travel time: Lee to Frida Kahlo	10	15	5
~~Node~~Intersection travel time: through Frida Kahlo	57	54	-

[1]Includes dwell time

Note: Averages based on four K/T off-peak period observations, three off-peak period 29 observations, four peak period K/T observations, and eight peak period 29 observations.

Source: Kittelson, 2020.

As Table 5~~Table 5~~ provides, the p.m. peak period travel time delays were ~~not substantial~~ relatively small based on the observations and data collection. The following observations provide context for travel times:

- During peak and off-peak periods, the ~~KT~~K/T showed consistent travel times between Lee Avenue and the intersection (or back of queue).
- The 29 includes a near side bus stop between Harold and Geneva avenues. Following this stop, the bus driver must reenter the traffic stream to continue along Ocean Avenue. A combination of red lights, associated re-entry delay (with a green or red indication), and slow operating speeds through the intersection resulted in similar peak hour and off-peak average travel times for the 29. Observed p.m. peak hour ~~node~~intersection travel times were widely variable, ranging from 21 seconds to 82 seconds.
- The K~~/~~/T line shares a travel lane with left-turning vehicles in a left-turn lane with a protected left-turn phase. ~~The intersection provides a protected left-turn phase~~Although ~~, so left-turning~~ drivers do not share a conflicting phase with crossing pedestrians and do not need to yield to oncoming traffic, the K/T (which continues straight) must wait behind left-turning vehicles at a red light while adjacent through traffic has a green indication, delaying the line relative to if it was in an exclusive lane or a through lane~~. However, the K/T may still wait behind a vehicle left-turning vehicle if the adjacent through traffic has a green indication but the protected left-turn phase has a red indication~~.

Commented [EW30]: Missing statement here.

Commented [MGA31R30]: Completed the statement.

Westbound

Table 6~~Table 6~~ provides average observed travel times in the westbound direction for the K/T Third/Ingleside~~K/T Third/Ingleside~~ and the 29 Sunset.

Commented [HT32]: I think more explanation can be provided about how this is different than the other locations. It could sound like a better situation because it is phase separated, but could go into more detail about how the train gets stuck because of the phase separation.

LWhite: Kittelson, please address but succinctly

Commented [MGA33R32]: Done.

Table 6: Transit Travel Time Delays Westbound at Ocean Avenue/Frida Kahlo Way/Geneva Avenue

Location	Off-Peak Nighttime Average Travel Time (seconds)	Peak Average Travel Time (seconds)	Difference in seconds
K/T Third/Ingleside~~K/T Third/Ingleside~~			
~~Link~~Segment travel time: Howth to Frida Kahlo	12	17	5
~~Node~~Intersection travel time: through Frida Kahlo	11	49	38
29 Sunset			
~~Link~~Segment travel time: Howth to Frida Kahlo	15	20	5
~~Node~~Intersection travel time: through Frida Kahlo	8	66	58

Note: Averages based on two ~~KT~~K/T off-peak period observations, two off-peak period 29 observations, six peak period ~~KT~~K/T observations, and 10 peak period 29 observations.
Source: Kittelson, 2020.

The following observations provide context for travel times:

- In the p.m. peak hour, the ~~KT~~K/T experienced an average of 38 seconds of travel time delay compared to off-peak conditions. This delay was mostly a result of red-light delay and of queuing once the ~~KT~~K/T left the separated track lane to the east of the intersection. No left turns are allowed from the center-running track lane, so the ~~KT~~K/T was not observed to be waiting behind turning vehicles. Rather, the limited green time and the queuing present contributed to higher p.m. peak hour travel times.
- The 29 experienced 58 seconds of relative delay to travel through the intersection in p.m. peak hour conditions compared to in off-peak conditions. Observations noted that the 29 frequently queued in advance of the intersection, in some cases back to Howth Street. As a result of queueing, buses missed green signal phases and waited for an extra signal cycle; the maximum intersection travel time observed in the p.m. peak observations was 213 seconds~~.~~.
- The 29 was observed to use the center-running track lane to bypass queuing on at least one occasion.
- This intersection is uniquely constrained compared to the other study Intersections:
  - It serves multiple approaches with higher volumes than the Brighton and Plymouth intersections. This includes cross-street volumes and through and turning movement volumes along Ocean Avenue. Much of the delay recorded was observed to be a result of queuing, likely as a result of the allocation of green time to competing intersection approaches.
  - The intersection includes longer pedestrian crossings across Ocean Avenue (in excess of 80 feet) than the other intersections, requiring longer side-street pedestrian crossings phases and a longer signal cycle than the other locations.

These constraints reduce the ability to provide capital improvement solutions compared to the other locations.

~~Ocean Avenue/Frida Kahlo Way/Geneva Avenue Findings~~

~~In the eastbound direction, the KT and the 29 were observed to experience less than 15 seconds of p.m. peak hour delay compared to off peak conditions. In the westbound direction, the KT, and the 29 experience substantial delay in traveling through the intersection—38 ad 58_, and 32 seconds, respectively. However, the signal currently includes a protected eastbound left-turn phases, prohibits westbound left turns, and provides a separated track lane for westbound K/T vehicles. The delays were observed to be a result of queueing and competing demands at the intersection.~~

Southbound

The 43 Masonic outbound route along Geneva at this location from one of two shared left-through lanes that do not include conflicting pedestrian or vehicle movements. As provided in Table 3.B-18 beginning on Response to Comments Section 4C pp. 4.C-40, project-related increase in vehicle traffic and passenger boarding/alighting activity would be associated with 82 seconds of travel time delay

Commented [HT34]: What was the max travel time? Might be helpful context to show variability.

LWhite: Kittelson, please address.

Commented [MGA35R34]: Included.

Commented [HT36]: This can be broadened. Yes, it has the highest side street volumes, but I believe it is also the highest volume Ocean Ave approaches within the study area (confirm). Also, it has some of the longest ped crossings, affecting min green times.

LWhite: Kittelson, let's discuss this one with Tony.

Commented [MGA37R36]: Updated per Tony's comments.

Commented [HT38]: What about the left-turn impacts?

LWhite: Kittelson, please address.

Commented [w39R38]: If this section is left in, that is.

Commented [MGA40R38]: Section removed.

Commented [HT41]: This statement seems out of place.

LWhite: Removed. Kittelson, please advise if we should keep.

Commented [MGA42R41]: Section removed.

during the p.m. peak hour. Travel time delay is attributable to passenger boarding activity, transit reentry time, and the level of vehicular traffic at the intersection and surrounding the Muni stop approximately 250 feet north of the intersection. The 2000 *Highway Capacity Manual* shows average bus re-entry delay into adjacent traffic streams to increase as a function of the adjacent lane hourly volumes, from an average of zero seconds with 100 vehicles to an average between four and six seconds at volumes between 400 and 600 vehicles per hour.[12] Data collected for this project show a southbound p.m. peak hour volume of 508 vehicles, which corresponds with an estimate of between four and six seconds of reentry delay in addition to delay at the intersection. As explained in the preceding section, this intersection is constrained by vehicle demand and pedestrian crossing lengths that limit possible signal timing solutions.

Combined Delay

Table 7~~Table 7~~ provides the recorded travel time delays presented above by line, direction, and location.

Table 7: P.M. Peak Hour Transit Travel Time Delays by Line

Location	Eastbound	Westbound
K/T Third/Ingleside~~K/T Third/Ingleside~~		
~~Node~~Intersection travel time: through Plymouth Avenue	14	25
~~Node~~Intersection travel time: through Brighton Avenue	26	~~37~~20
~~Node~~Intersection travel time: through Frida Kahlo Way	14	38
Total Combined Delay	**54**	**~~100~~83**
29 Sunset		
~~Link~~Segment Travel Time: Lee to Brighton	n/a	~~9~~11
~~Node~~Intersection travel time: through Brighton Avenue	16	~~23~~30
~~Node~~Intersection travel time: through Plymouth	-	30
~~Node~~Intersection travel time: through Frida Kahlo Way	-	58

[12] 2000 *Highway Capacity Manual*, Chapter 27, Exhibit 27-10. Reproduced in the "Public Transit" appendix of the *2019 San Francisco Transportation Impact Analysis Guidelines* and available at https://sfplanning.org/project/transportation-impact-analysis-guidelines-environmental-review-update#impact-analysis-guidelines

Total Combined Delay	**16**	**~~120~~129**

Source: Kittelson, 2020.

Commented [MGA43]: Westbound column updated per my comments in Table 2.

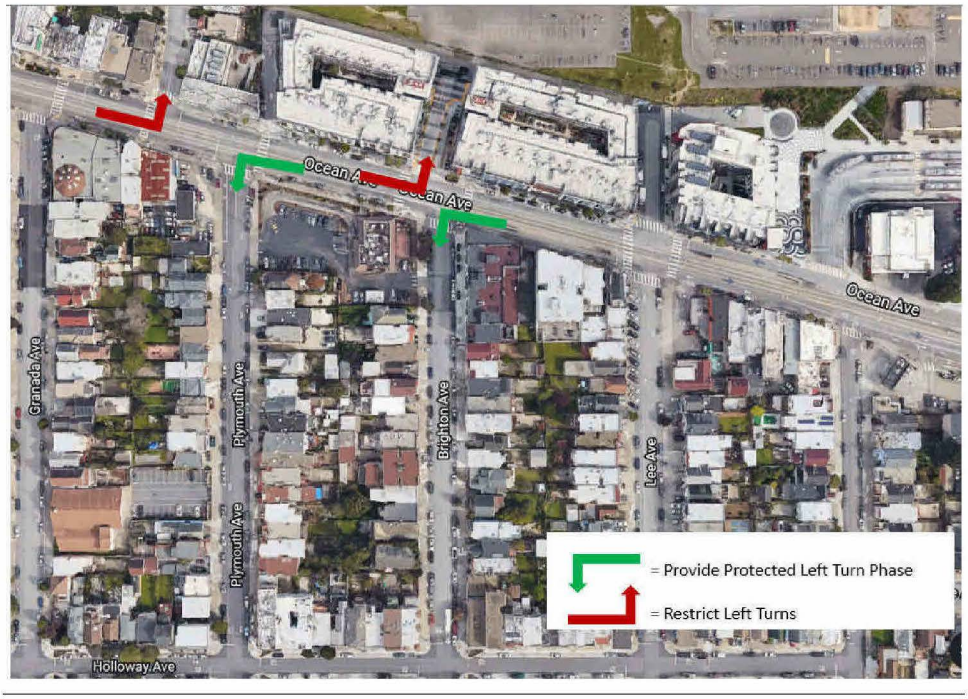
RECOMMENDED IMPROVEMENTS

The following improvements are recommended to reduce transit travel times in the study area and are displayed in **Construct a** bus boarding island on southbound Frida Kahlo Way.

Figure 2~~**Figure 2**~~. These proposed improvements require approval by the SFMTA and are subject to review by relevant rail oversight authorities.

- Providing a protected green arrow signal phase for westbound left turns at Ocean Avenue/Brighton Avenue;
- Prohibit eastbound left turns at Ocean Avenue/Brighton Avenue;
- Providing a protected green arrow signal phase for westbound left turns at Ocean Avenue/Plymouth Avenue; ~~and~~
- Prohibit eastbound left turns at Ocean Avenue/Plymouth Avenue~~;~~ and
- Construct a bus boarding island on southbound Frida Kahlo Way.

Figure 2: Recommended Improvements to Reduce Transit Travel Times



Source: Google Earth.

Ocean Avenue/Brighton Avenue

Eastbound: Prohibit Left Turns

At Ocean and Brighton avenues, prohibiting eastbound left turns would provide dual benefit to transit operations. It would eliminate transit delay for the K/T associated with waiting behind left-turning vehicles, which was observed to result in missing green phases. A left turn prohibition would also provide more through volume capacity and would give through drivers the ability to choose a lane rather than to proceed in the right lane. This would benefit the 29 as well, whose drivers would either travel in a right lane with fewer vehicles or could also use the left lane to travel through the intersection if right-turning vehicles are yielding to crossing pedestrians.

Implementing this improvement would improve reliability for the K/T and 29 and could reduce p.m. peak hour travel time delay compared to off-peak travel times by up to 26 and 16 seconds, respectively. There is no guarantee that the improvement would reduce delay by the full amounts observed, given there are other sources of transit delay.

Commented [HT44]: Don't know if I fully agree with this statement. The concept would be a lagging phase, so the queuing could still exist during the permissive phase, so it may not change lane choice much.

LWhite: Kittelson, let's discuss with Tony.

Commented [MGA45R44]: Per discussion on 3/24, no update.

Commented [HT46]: This is the maximum observed difference in travel time, but does not necessarily mean that it could be fully mitigated by the signal phase change. A following transit vehicle would still need to wait for a turning vehicle to clear, while this would hopefully be less than today, it would not be a complete elimination of that delay. Also, there's still potential for other sources of delay.

LWhite: Kittelson, please acknowledge this in the statement but then still end with the point that this improvement would reduce p.m. peak period travel times by 26 and 16 seconds.

Commented [MGA47R46]: Acknowledged.

Westbound: Provide Protected/Permissive Left Turn Phasing

At Ocean and Brighton avenues, providing a protected green arrow left turn phase would allow left-turning vehicles a dedicated portion of the signal phase and would reduce delay for the K/T associated with waiting behind those left-turning vehicles. This improvement would improve reliability for the K/T and could reduce delay by up to ~~37~~ 20 seconds. There is no guarantee that the improvement would reduce delay by the full amounts observed, as the K/T line would need to wait for a turning vehicle to clear even though the movement would be more reliable with a protected/permissive phase.

Ocean Avenue/Plymouth Avenue

Eastbound: Prohibit Left Turns

At Ocean and Plymouth avenues, prohibiting eastbound left turns would provide dual benefit to transit operations. It would eliminate transit delay for the K/T associated with waiting behind left-turning vehicles, which was observed to result in missing green phases. A left turn prohibition would also provide more through volume capacity and would give through drivers the ability to choose a lane rather than to proceed in the right lane. This improvement would improve reliability for both lines and could reduce delay for the K/T by up to 14 seconds. There is no guarantee that the improvement would reduce delay by the full amounts observed, given there are other sources of transit delay.

Commented [HT48]: Similar to earlier comments. Although left-turn delay would be eliminated, there could be other sources of delay still.

LWhite: See my response to earlier comment and address as well.

Commented [MGA49R48]: Updated here and in the protected/permissive phasing sections.

Westbound: Provide Protected/Permissive Left Turn Phasing

At Ocean and Brighton avenues, providing a protected/permissive left turn phase would allow left-turning vehicles a dedicated portion of the signal phase and would reduce delay for the ~~KT~~K/T associated with waiting behind those left-turning vehicles. This improvement would improve reliability for the ~~KT~~K/T. This benefit would also accrue to the 29, which turns left at the intersection and is subject to the same travel delays. This improvement would improve reliability for both lines and could reduce delay for the ~~KT~~K/T by up to 25 seconds and for the 29 by up to 30 seconds. There is no guarantee that the improvement would reduce delay by the full amounts observed, as the ~~KT~~K/T and 29 lines would need to wait for a turning vehicle to clear even though the movement would be more reliable with a protected/permissive phase.

Frida Kahlo Way/ Ocean Avenue/Geneva Avenue

Southbound: ~~Prohibit Left Turns~~Transit Boarding Island

The improvement identified to improve transit operations at this intersection is the addition of a transit boarding island along the southbound approach of Frida Kahlo Way. A transit boarding island would be an extension of the sidewalk at the location of the stop that would reduce passenger boarding and re-entry delay associated with accessing the bus stop. The SFMTA Transportation Engineering *Transit Preferential Toolkit* identifies that transit boarding islands typically reduce passenger boarding/alighting delay by an average of five seconds and reduce re-entry delay by an average of five seconds. This location may be associated with more passenger boarding/alighting delay than five seconds. The boarding island would reduce transit reentry delay, which would in turn allow Muni buses better access to the signal, potentially reducing delay at the intersection by proceeding through on more green signals or getting better position in a queue.

~~Feasible capital improvement recommendations to improve transit operations were not identified. Improvements that privilege operations along Ocean Avenue (e.g., more green time for Ocean Avenue approaches) would bring disbenefit to the 43 and 49 lines traveling along Frida Kahlo Way at the same intersection. Constrained right-of-way limits quick-build improvement options, as well.~~

Conclusion

The recommended improvements further refine the capital measures identified as part of **Project Mitigation Measure M-C-TR-4: Monitor Cumulative Transit Travel Times and Implement Measures to Reduce Transit Delay.**

SECONDARY EFFECTS OF IMPLEMENTING IMPROVEMENTS

The following describes the secondary construction and operational effects of implementing the improvements identified above.

Construction

Construction to implement the identified capital improvements would include the following:

- Installation of signage for the prohibited left turns at both Brighton and Plymouth avenues.
- Installation of additional signal heads, possibly including a new mast arm, to provide protected/permissive phasing in the eastbound direction at Plymouth and Brighton avenues.

This level of construction would cause temporary disruption to existing operating conditions and would require a logistics plan to ensure continued service is provided for all travel modes and road users in the interim.

~~Describe in one paragraph~~

General Effect to Vehicle Traffic

The reliability and delay reduction benefits described for transit vehicles along Ocean Avenue as a result of the proposed changes would also accrue to general traffic along Ocean Avenue. Anticipated effects are discussed below:

- For westbound left-turning drivers at Plymouth and Brighton avenues, a protected/permissive phase provides dedicated time to make the left turn separated from oncoming traffic or pedestrians. It would also provide a safety benefit with the provision of the protected movement.
- The westbound protected left-turn phase would occupy a share of green time and would result in a decrease in green time of a few seconds to other phases.
- For eastbound through drivers along Ocean Avenue, the prohibition of left turns at Plymouth and Brighton avenues would improve travel times and reliability, eliminating instances of delay from waiting behind a left-turning vehicle.

Effects on left-turning drivers at Plymouth or Brighton avenues are discussed in the Circulation section below.

Pedestrian Benefits

The Ocean Avenue/Plymouth Avenue intersection serves many pedestrians in the p.m. peak hour. These pedestrians share a signal phase with the parallel Ocean Avenue movements, including the right-turn, and left-turn movements. The shared vehicle turning movements and pedestrian crossings create a conflict between road users and contributes travel time delay for turning drivers yielding to pedestrians. The two intersections with recommended improvements serve the following number of pedestrians:

- **Ocean Avenue/Brighton Avenue:** 442 pedestrians across north leg, 278 pedestrians across south leg in the weekday p.m. peak hour (5-7 p.m.; see Appendix A)

- **Ocean Avenue/Plymouth Avenue:** 349 pedestrians across north leg, 152 pedestrians across south leg in the weekday p.m. peak hour (5-7 p.m.; see Appendix A)

For pedestrians crossing the north legs of these intersections, conflicting left-turning vehicles would be eliminated. For pedestrians crossing the south legs of these intersections, conflicts with left-turning drivers would be reduced. Separating the left-turning conflicts provides a safety benefit to pedestrians crossing Plymouth and Brighton avenues.

General Effect on Circulation

The identified improvements wouldwill have the following anticipated effect on circulation within the study area:

- **The prohibition of eastbound left turns at Ocean and Plymouth avenues.** Prohibiting this movement wouldwill redistribute the 11 left-turning drivers currently making this movement in the p.m. peak hour. These drivers would have the following options (see **Construct a** bus boarding island on southbound Frida Kahlo Way.
- Figure 2~~Figure 2~~):
  - Turn left at Faxon, Miramar, or Granada avenues in advance of the Plymouth Avenue intersection; or
  - Turn right at Granada Avenue, left to Holloway Avenue, and then left at Plymouth Avenue, left at Ocean Avenue, and right at Plymouth Avenue, adding approximately 1,700 feet of diversion to their trip.
- **The prohibition of eastbound left turns at Ocean and Brighton avenues.** Prohibiting this movement wouldwill redistribute the 39 left-turning drivers currently making this movement in the p.m. peak hour. These drivers would have the following options (see **Construct a** bus boarding island on southbound Frida Kahlo Way.
- Figure 2~~Figure 2~~):
  - Turn right at Plymouth, Granada, or Miramar avenues, left at Brighton Avenue, and through at Ocean Avenue, adding approximately 1,700 feet of diversion to their trip. Transit travel time and reliability benefits accrue to general traffic.

  Note that Brighton Avenue provides vehicular access to the Whole Foods parking deck and to Avalon Ocean Avenue residential parking.

Both prohibitions would redistribute ~~these~~ approximately the number of left-turning trips presented above and would increase the traffic on the relevant local streets by an amount commensurate to the existing eastbound left-turn volumes.

Commented [HT50]: Are we saying something more about impacts to side streets, even in a qualitative point of view.

LWhite: Kittelson, let's discuss this comment with Tony

Commented [w51R50]: Yes, please provide more here – what that means to transit and safety in particular. It can be a short summary.

Commented [MGA52R50]: Brief discussion added.

The capital improvements and potential diversions discussed above would not be expected to create conflicts or delays to existing transit operations and would not create safety- hazards to people walking, biking, driving, or taking transit. Plymouth, Granada, Miramar, Brighton, and Holloway avenues are low-speed local roads that can accommodate the marginal increase in trips.

APPENDIX A: MULTIMODAL TURNING MOVEMENT COUNTS

APPENDIX B: PEAK HOUR DATA COLLECTION

Commented [EW53]: Please remove the 22188 from the top of the sheets.

Commented [w54R53]: It would be helpful if appendix B and C looked the same format too, but don't prioritize this if challenging.

Commented [MGA55R53]: 21888 removed. Making them uniform would be a relatively big lift, so we did not do this per Wade's guidance.

APPENDIX C: OFF-PEAK (NIGHTTIME) DATA COLLECTION

Commented [EW56]: Appendix C should remove references to the historical travel times. Those are included in Appendix D and it's confusing to introduce them and make a comparison in Appendix C when they haven't been included yet.

Commented [MGA57R56]: Since (a) the comparison to historical travel is critical for the process documented here and (b) these appendixes follow the order presented in the memo…I've put a footnote in all pages of this appendix that simply refer the reader to Appendix D for historical travel times.

APPENDIX D: HISTORICAL SFMTA MUNI TRAVEL TIMES