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## FINAL MEMORANDUM

**DATE:** April 6, 2016

**TO:** Anthony Buczek, PE, PTOE Metro  
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**FROM:** Randy Johnson, PE, PTOE  
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**SUBJECT:** FINAL Hogan Model Powell-Division Vissim Analysis Results

P# 15198-000

The purpose of this memorandum is to document the results of the Vissim microsimulation analysis for the Powell-Division Transit and Development Project. This memo includes an overview of the Hogan Drive area scenario analyzed, key model assumptions, and a summary of results. The following modeling scenarios are documented for this analysis:

- 2035 PM No Build: Hogan Drive Model Area
- 2035 PM No Build with BRT: Hogan Drive Model Area
- 2035 PM Build-Option 1: Hogan Drive Model Area
- 2035 PM Build-Option 3 “Transit Alley”: Hogan Drive Model Area

The design team developed another option – Option 2 – which was not analyzed due to its similarity in operational performance to Option 1. This option may be considered further, with performance comparable to that of Option 1.

### Summary of Scenarios

A summary of the scenarios modeled for the Vissim analysis are outlined as follows:

#### 2035 PM No Build: Hogan Drive Model Area

The 2035 No Build scenario for Hogan Drive model area assumes optimized signal split timing, existing geometry, and transit service except for the following:

- **Stark Street/Kane Drive:** Westbound right turn overlap signal phases were added during the southbound left turn phase. Southbound right turn overlap added during the eastbound left turn phase. The southbound left turn lane was extended roughly 200 feet to accommodate the additional volume through use of the existing two-way-left turn lane.
- **Burnside Road/Hogan Drive:** Hogan Drive was widened to accommodate two southbound left turn lanes and two southbound thru lanes beginning about 300 feet upstream of the stop bar and continues

through the intersection, reflecting the currently planned project. Eastbound right turn overlap added during the northbound phase.

- **Cleveland Avenue/Burnside Road:** The southbound left-turn pocket was extended to account for the additional demand. The left turn phasing on Cleveland Avenue changed to protected/permitted (previous permitted only), reflecting the currently planned project.
- **Burnside Road/Division Street:** Eastbound and westbound right turn overlaps added during the northbound and southbound left turn phases, respectively.

## **2035 PM No Build with BRT: Hogan Drive Model Area**

The 2035 No Build with BRT scenario for Hogan Drive model area includes all changes from the **No Build** scenario described above and the following key elements:

- MHCC Transit Center added to the eastside of campus, refer to Figure 1.
- Bus Rapid Transit (BRT) Routes, both eastbound and westbound, added between Division Street/Cleveland Avenue and MHCC. The eastbound and westbound BRT alignments operate in existing lanes with mixed traffic at 5 minute headways.
  - Westbound BRT runs from the MHCC Transit Center to Division Street/Cleveland Avenue via Stark Street, Hogan Drive, Hogan Place, Division Street and, Cleveland Avenue. There are seven transit stops along this alignment; the first at MHCC Transit Center. There are five far-side transit stops at Stark Street/Kane Drive, Stark Street/Sundial Avenue, Hogan Drive/Stark Street, Hogan Drive/23<sup>rd</sup> Avenue and Division Street/Cleveland Avenue, and one near-side transit stop at Division Street/Hogan Place.
  - Eastbound BRT runs from Division Street/Cleveland Avenue to MHCC Transit Center via Cleveland Avenue, Division Street, Hogan Drive and Stark Street. There are seven transit stops along this alignment; the first is a near-side transit stop on Cleveland Avenue at Division Street. There are five far-side transit stops at Division Street/ Hogan Drive, Hogan Drive/23<sup>rd</sup> Avenue, Hogan Drive/Stark Street, Stark Street/Sundial Avenue and Stark Street/Kane Drive. The final stop along with a 5 minute lay-over period is at MHCC Transit Center.
- **Hogan Drive/Stark Street:** The eastbound far-side transit stop will be combined with the existing TriMet Route 20 transit stop.
- **Stark Street/Kane Drive:** The westbound far-side transit stop will be combined with the existing TriMet Route 20 transit stop.



Figure 1: Vissim Screenshot - No Build with BRT Scenario: Mt. Hood Community College (MHCC) Transit Center

### 2035 PM Build-Option 1: Hogan Drive Model Area

The 2035 Build-Option 1 scenario includes all changes from the **No Build with BRT** scenario described above and the following key elements:

- Transit Signal Priority (TSP) was added at all signalized intersections along both the eastbound and westbound alignment. The TSP thresholds allow for up to 15 seconds of extension with no more than 10 seconds allowed to be taken from a conflicting through movement. The intersections included: Cleveland Avenue/Division Street, Division Street/Burnside Road, Division Street/Hogan Drive, Hogan Drive/23<sup>rd</sup> Avenue, Hogan Drive/Stark Street, Stark Street/Sundial, Stark Street/McGinnis Avenue & Hale Avenue, and Stark Street/Kane Drive.
- A transit-only signal was added at the new MHCC Transit center entrance along Stark Street.
- **Division Street/Hogan Drive:** Division Street was widened to include an eastbound BRT-only left-turn lane. The eastbound left-turn phase was given 4 additional seconds; the westbound phase was reduced by 4 seconds to keep the cycle length consistent. In addition, the BRT eastbound left-turn phase was given a 7 second lead relative to the motor vehicle eastbound left-turn phase to allow the BRT to start the turn movement ahead of traffic.
- **Division Street/Hogan Place:** Eastbound left-turn and southbound left-turn movements restricted, due to the addition of the eastbound BRT-only left turn lane.
- **Hogan Drive /Hogan Place:** Southbound Hogan Drive widened to include a southbound right-turn lane beginning about 250 feet upstream of the intersection.
- **Hogan Drive/Stark Street:** Hogan Drive widened to include a northbound BRT/right-turn lane beginning about 250 feet upstream of the intersection. Stark Street widened to include a westbound BRT-only left turn lane. The BRT westbound left-turn phase was given a 7 second lead relative to the motor vehicle westbound left-turn phase.

- **Stark Street/Kane Drive:** The lead/lag left-turn phase sequence was switched to give the northbound left-turn phase the lead over the southbound phase. Originally, the southbound phases would initiate a cycle, followed by the northbound thru phase (after the southbound phase terminates) and finally the northbound left-turn phase (after then southbound thru phase terminates). The modification called the northbound phases at the beginning of a cycle and the southbound thru and southbound left-term phases followed.
- The eastbound and westbound alignments generally operate in existing lanes with mixed traffic except locations with a BRT-only or BRT/right-turn lane, described above.

### **2035 PM Build-Option 3 “Transit Alley”: Hogan Drive Model Area**

The 2035 Build-Option 3 scenario includes all changes from the **No Build with BRT** scenario described above expect for the Eastbound BRT alignment:

- Eastbound BRT runs from Cleveland Avenue/8<sup>th</sup> Street to MHCC Transit Center via Cleveland Avenue, 8<sup>th</sup> Street, Hogan Drive and Stark Street. There are six transit stops along this alignment. There are five far-side transit stops at Division Street/ Hogan Drive, Hogan Drive/23<sup>rd</sup> Avenue, Hogan Drive/Stark Street, Stark Street/Sundial Avenue and Stark Street/Kane Drive. The final stop along with a 5 minute lay-by period is at MHCC Transit Center.

A key component of Option 3 is the ‘transit alley’ alignment described and shown below.

- **8<sup>th</sup> Street to Hogan Drive:** In this segment the eastbound BRT alignments would operate in existing lanes with mixed traffic. The BRT would travel eastbound along 8<sup>th</sup> Street, cross Burnside Road to the existing driveway between Washington Federal and Washman Auto Spas. The BRT would continue

through the alley and exit at the driveway between Bank of the West and Subway onto Hogan Drive, refer to Figure 2.



• Figure 2: Vissim Screenshot - Option 3 Scenario: "Transit Alley" Alignment

In addition the following key elements were also modified (in comparison to the No Build with BRT scenario):

- Transit Signal Priority (TSP) was added at all existing signalized intersections along both the eastbound and westbound alignment. The TSP thresholds allow for up to 15 seconds of extension with no more than 10 seconds allowed to be taken from a conflicting through movement. The intersections included: Cleveland Avenue/Division Street, Division Street/Burnside Road, Division Street/Hogan Drive, Hogan Drive/23<sup>rd</sup> Avenue, Hogan Drive/Stark Street, Stark Street/Sundial, Stark Street/McGinnis Avenue & Hale Avenue, and Stark Street/Kane Drive.
- A transit-only signal was added at the new MHCC Transit center entrance along Stark Street.
- **Burnside/8<sup>th</sup>:** Install a traffic signal with transit signal priority. All movements allowed except westbound thru and westbound left-turn. The eastbound thru movement is permitted to provide access

to the businesses adjacent to the existing driveway, however vehicles will not be allowed to continue to Hogan Drive.

- **Hogan Drive/Transit Alley Driveway:** Install a traffic signal with transit signal priority. All movements allowed except northbound left-turn. Crosswalk is added only on the south leg and times concurrently with the eastbound approach.
- **Hogan Drive /Hogan Place:** Hogan Drive widened to include a southbound BRT/right-turn lane beginning about 250 feet upstream of the intersection.
- **Hogan Drive/Stark Street:** Hogan Drive widened to include a northbound BRT/right-turn lane beginning about 250 feet upstream of the intersection. Stark Street widened to include a westbound BRT-only left turn lane. The BRT westbound left-turn phase was given a 7 second lead relative to the motor vehicle westbound left-turn phase to allow the BRT to complete the turning movement. The southbound left-turn phase was given 5 additional seconds; the eastbound and westbound through phases were reduced by 5 seconds to keep the cycle length consistent. The eastbound far-side transit stop will be combined with the existing TriMet Route 20 transit stop.
- **Stark Street/Kane Drive:** Eastbound cross section on Stark Street modified to include 3 lanes: one left-turn only lane, one thru lane, and one right-turn only lane (removes the through movement from the existing through-right lane). The phase sequence was modified to give the northbound phase the lead over the southbound phase. The westbound far-side transit stop will be combined with the existing TriMet Route 20 transit stop.
- The eastbound and westbound alignments generally operate in existing lanes with mixed traffic except locations with a BRT-only or BAT lane, described above.

## Key model assumptions

The following model assumptions apply to all build scenarios.

- 2035 BRT headways are 5 minutes
- 2035 No Build and build non-BRT transit service match TriMet's existing schedule.
- Transit signal priority is enabled at all impacted signalized intersections in the models, however, opportunities are limited due to congested and coordinated traffic signals with side streets operating at minimum time to serve pedestrians.

## Summary of Results

The following key Powell-Division Vissim analysis results are based on model observations and the measures of effectiveness results for motor vehicles and transit detailed in tables 1-5 below.

### ***Hogan Model Area Vissim Analysis Results***

- Average PM peak hour westbound motor vehicle travel time from Stark Street/Kane Drive to Cleveland Avenue/Division Street increases by 15% while the eastbound motor vehicle travel time from Cleveland Avenue/Division Street decreases by 10% from 2015 to 2035 under No Build conditions.

- There is no significant difference in westbound and eastbound motor vehicle travel time between Stark Street/Kane Drive to Cleveland Avenue/Division Street under No Build and No Build with BRT conditions.
- Options 1 and 3 each save approximately 2 minutes of westbound BRT travel time from Stark/Kane to Cleveland/Division during the PM peak compared to the No Build with BRT.
- Options 1 and 3 each save approximately 3 minutes of eastbound BRT travel time from Cleveland/Division to Stark/Kane during the PM peak compared to the No Build with BRT. There is no significant difference in the westbound PM BRT travel time from Stark Street/Kane Drive to Cleveland Avenue/Division Street between Options 1 and 3.
- Under the Option 3 “Transit Alley” scenario, the eastbound PM BRT travel time from Cleveland Avenue/Division Street to Stark Street/Kane Drive is 30 seconds less than Option 1. In addition, avoiding the intersection of Burnside Street/ Division Street and aligning the EB BRT route on a major thru movement (as opposed to a left-turn movement in Option 1) lessens the delay by about 40 seconds compared to the Option 1 scenario.
- Westbound and eastbound PM BRT travel time reliability for both build scenarios slightly improves compared to the No Build with BRT scenario.
- There is no significant difference in westbound and eastbound PM BRT travel time reliability between Options 1 and 3.
- There is no significant difference in the motor vehicle intersection delay experienced at all study intersections between all four future scenarios (No Build, No Build with BRT, Option 1, and Option 3 “Transit Alley”).

**Table 1: Motor Vehicle Travel Time – Hogan PM**

Measure of Effectiveness	Hogan PM					
	Direction / Location	Existing	Future No Build	Future No Build with BRT	Opt #1 Hogan	Opt #3 Transit Alley
Travel time (Min:Sec)	Stark EB Motor Vehicle (Hogan to Kane)	02:05	02:08	02:16 <sup>e</sup>	02:15 <sup>e,f</sup>	N/A <sup>e,f,m</sup>
Travel Time Segment Delay		00:51	00:55	01:03	01:01	N/A
Travel time (Min:Sec)	Stark WB Motor Vehicle (Kane to Hogan)	02:04	02:20 <sup>a</sup>	02:14 <sup>a,e</sup>	02:26 <sup>a,e,f,i</sup>	02:25 <sup>a,e,f,i</sup>
Travel Time Segment Delay		00:51	01:07	01:01	01:13	01:12
Travel time (Min:Sec)	Hogan SB Motor Vehicle (Stark to Division)	02:49	03:15	03:26 <sup>e</sup>	03:13 <sup>e,f,h</sup>	03:08 <sup>e,f,h,k</sup>
Travel Time Segment Delay		01:12	01:38	01:49	01:36	01:31
Travel time (Min:Sec)	Hogan NB Motor Vehicle (Division to Stark)	02:25	02:37	02:42 <sup>e</sup>	02:37 <sup>e,f,i</sup>	02:36 <sup>e,f,i,k</sup>
Travel Time Segment Delay		00:46	00:58	01:03	00:58	00:58
Travel time (Min:Sec)	Division EB Motor Vehicle (Cleveland to Hogan)	02:42	01:43 <sup>c</sup>	01:48 <sup>c</sup>	01:42 <sup>c,f,g</sup>	01:53 <sup>c,f</sup>
Travel Time Segment Delay		02:05	01:06	01:11	01:05	01:15
Travel time (Min:Sec)	Division WB Motor Vehicle (Hogan to Cleveland)	01:46	02:18 <sup>c</sup>	02:22 <sup>c</sup>	02:05 <sup>c,f</sup>	02:11 <sup>c,f</sup>
Travel Time Segment Delay		01:09	01:41	01:45	01:28	01:34
Travel time (Min:Sec)	Burnside SB Motor Vehicle (Cleveland to Hogan)	01:40	02:07 <sup>b,d</sup>	02:11 <sup>b,d</sup>	02:14 <sup>b,d,f</sup>	02:34 <sup>b,d,f,j</sup>
Travel Time Segment Delay		00:47	00:00	01:18	01:21	01:40
Travel time (Min:Sec)	Burnside NB Motor Vehicle (Hogan to Cleveland)	01:29	01:55	01:54	02:06 <sup>f</sup>	02:16 <sup>f,j</sup>
Travel Time Segment Delay		00:37	01:02	01:02	01:13	01:24

<sup>a</sup> – At Stark Street/Kane Drive: WBR overlap added during the SBL phase  
<sup>b</sup> – At Burnside Road/Cleveland Avenue: SBL pocket extended; NBL and SBL phase changed to protected/permitted  
<sup>c</sup> – At Burnside Road/Division Street: EBR and WBR overlap added during NBL and SBL phases, respectively  
<sup>d</sup> – At Burnside Road/Hogan Drive: SB widen to include dual SBT and SBL lanes; EBR overlap added during the NB phase  
<sup>e</sup> –BRT transit stop  
<sup>f</sup> – Signalized intersections given transit signal priority  
<sup>g</sup>– At Division Street/Hogan Drive – EB widened to include a EBLT BRT-only lane  
<sup>h</sup>- At Hogan Drive/Hogan Place – SB widened to include a right-turn only lane about 250 feet upstream  
<sup>i</sup> – At Hogan Drive/Stark Street: NB widened to include a NB right-turn only lane and WB widened to include a WBLT BRT-only lane  
<sup>j</sup>- At Burnside Road/8<sup>th</sup> Street: Add traffic signal with transit signal priority  
<sup>k</sup> – At Hogan Drive/Transit Alley Driveway: Add traffic signal with transit signal priority  
<sup>m</sup> – At Stark Street/Kane Drive: EB cross section modified to include 3 lanes: one left-turn only lane, one thru lane, and one right-turn only lane

**Table 2: Motor Vehicle Delay – Hogan PM**

Measure of Effectiveness	Hogan PM					
	Direction / Location	Existing	Future No Build	Future No Build with BRT	Opt #1 Hogan	Opt #3 Transit Alley
Intersection Delay (Average Delay Per Vehicle)	Kane/29th	10	11	11	11	11
	Stark/Kane	82	127	126	129	125
	Stark/McGinnis Hale	12	11	11	13	14
	Stark/Sundial	9	11	12	13	12
	Stark/Hogan	42	53	56	69	68
	Hogan/23rd	6	13	14	13	13
	Hogan/Hogan Place	2	9	13	10	11
	Hogan/Division	43	61	64	68	65
	Hogan Place/Division	12	7	8	11	12
	Hogan/Burnside	32	47	47	49	45
	Division/Burnside	41	52	54	54	56
	Division/Cleveland	20	27	29	32	34
	Burnside/Cleveland	25	40	40	41	43

**Table 3: Transit Travel Times – Hogan PM**

Measure of Effectiveness	Hogan PM						Travel Time Improvement	
	Direction / Location	Existing	Future No Build	Future No Build with BRT	Opt #1 Hogan	Opt #3 Transit Alley	Future No Build with BRT - Option #1	Future No Build with BRT - Option #3
Travel time (Min:Sec)	WB BRT (MHCC to Cleveland)	07:04	08:06 <sub>a,c</sub>	11:53 <sub>a,c,e</sub>	09:48 <sub>a,c,e,f,i</sub>	09:59 <sub>a,c,e,f,i</sub>	02:05	01:54
Travel Time Segment Delay		03:24	04:24	04:18	04:07	04:17	00:11	00:01
Travel time (Min:Sec)	EB BRT (Cleveland to MHCC)	06:59	08:15 <sub>c</sub>	12:54 <sub>c,e</sub>	10:03 <sub>c,e,f,g,h,i</sub>	09:27 <sub>c,e,f,h,i,j,k,m</sub>	02:52	03:27
Travel Time Segment Delay		03:21	04:39	05:17	04:12	03:27	01:05	01:50
Travel time (Min:Sec)	WB BRT (18th to Cleveland)			04:15 <sub>c,e</sub>	03:34 <sub>c,e,f</sub>	03:35 <sub>c,e,f</sub>	00:41	00:40
Travel Time Segment Delay				01:58	01:50	01:50	00:08	00:08
Travel time (Min:Sec)	EB BRT (Cleveland to 18th)			05:38 <sub>c,e</sub>	03:52 <sub>c,e,f,g,h</sub>	03:31 <sub>c,e,f,h,j,k</sub>	01:46	02:07
Travel Time Segment Delay				03:18	02:02	01:29	01:16	01:49
Travel time (Min:Sec)	WB BRT (Sundial to 18th)			04:57 <sub>e</sub>	04:01 <sub>e,f,i</sub>	04:05 <sub>e,f,i</sub>	00:56	00:52
Travel Time Segment Delay				01:34	01:27	01:32	00:06	00:01
Travel time (Min:Sec)	EB BRT (18th to Sundial)			04:01 <sub>e</sub>	03:03 <sub>e,f,i</sub>	03:05 <sub>e,f,i</sub>	00:57	00:55
Travel Time Segment Delay				00:59	00:50	00:55	00:08	00:04
Travel time (Min:Sec)	WB BRT (MHCC to Sundial)			02:39 <sub>a,e</sub>	02:17 <sub>a,e,f</sub>	02:22 <sub>a,e,f</sub>	00:21	00:17
Travel Time Segment Delay				00:46	00:00	00:59	00:46	-00:13
Travel time (Min:Sec)	EB BRT (Sundial to MHCC)			03:13 <sub>e</sub>	03:11 <sub>e,f</sub>	02:55 <sub>e,f,m</sub>	00:02	00:18
Travel Time Segment Delay				00:59	01:24	01:08	-00:25	-00:09

<sup>a</sup> – At Stark Street/Kane Drive: WBR overlap added during the SBL phase

<sup>c</sup> – At Burnside Road/Division Street: EBR and WBR overlap added during NBL and SBL phases, respectively

<sup>e</sup> –BRT transit stop

<sup>f</sup> – Signalized intersections given transit signal priority

<sup>g</sup>- At Division Street/Hogan Drive – EB widened to include a EBLT BRT-only lane

<sup>h</sup>- At Hogan Drive/Hogan Place – SB widened to include a right-turn only lane about 250 feet upstream

<sup>i</sup> – At Hogan Drive/Stark Street: NB widened to include a NB right-turn only lane and WB widened to include a WBLT BRT-only lane

<sup>j</sup>- At Burnside Road/8<sup>th</sup> Street: Add traffic signal with transit signal priority

<sup>k</sup> – At Hogan Drive/Transit Alley Driveway: Add traffic signal with transit signal priority

<sup>m</sup> – At Stark Street/Kane Drive: EB cross section modified to include 3 lanes: one left-turn only lane, one thru lane, and one right-turn only lane

**Table 4: Transit Delay at Key Movements along Hogan Drive– Hogan PM No Build with BRT Scenario**

Average Delay Table - No Build + BRT			
Intersection	Approach/Movement	Volume	Average Delay (s)
NE 242nd Dr & NE Division St	EBL	12	74
SE Hogan Dr & SE Stark St	NBR	12	30
SE Hogan Dr & SE Stark St	WBL	11	74

**Table 5: Transit Delay at Key Movements along Hogan Drive– Hogan PM Option #1 Scenario**

Average Delay Table - Option 1			
Intersection	Approach/Movement	Volume	Average Delay (s)
NE 242nd Dr & NE Division St	EBL	12	48
SE Hogan Dr & SE Stark St	NBR	12	12
SE Hogan Dr & SE Stark St	WBL	12	60

**Table 6: Motor Vehicle 95th Percentile Queue Length - Hogan PM**

Hogan PM		95th Percentile Queue				
Intersection	Movement	Existing	Future No Build	Future No Build with BRT	Opt #1 Hogan	Opt #3 Transit Alley
NE Burnside Rd & NE Division St	WBT	459	704	821	882	887
	WBR	186	160	170	210	157
	WBL	119	178	167	209	196
	SBT	436	547	548	589	582
	SBL	450	657	597	810	646
	EBT	512	1096	1381	1362	1235
	EBR	512	1182	1412	1375	1303
	EBL	124	150	161	206	173
	NBT	281	547	540	902	948
NBL	343	408	400	841	517	
NE 242nd Dr & NE Division St	WBT	358	438	446	634	618
	WBR	71	72	72	76	67
	WBL	223	226	255	657	705
	SBT	968	1544	2016	1710	1963
	SBL	459	920	1728	1547	1446
	EBT	428	428	443	401	485
	EBL	367	490	617	735	612
	NBT	427	605	665	754	883
NBL	114	157	175	181	165	
SE Hogan Dr & SE Stark St	WBT	425	625	583	747	654
	WBL	274	288	338	314	280
	SBT	468	770	1171	2679	2286
	SBL	358	435	648	2689	2296
	EBT	458	635	576	697	631
	EBL	204	261	275	309	288
	NBT	558	628	651	610	628
NBL	177	300	235	315	262	
SW 257th Ave & SE Stark St	WBT	220	255	2907	279	274
	WBR	71	79	79	92	89
	WBL	160	160	181	227	236
	SBT	2519	2533	2526	2543	2534
	SBR	2523	2533	2528	2527	2527
	SBL	2252	323	316	440	363
	EBT	547	544	778	791	916
	EBL	202	385	394	441	361
	NBT	313	441	427	563	518
NBL	368	636	2724	680	595	