City of Sandy

Agenda

City Council Goal Setting
Sandy Library Community Room
38980 Proctor Blvd
Meeting Date: Saturday, March 5, 2022
Meeting Time: 9:00 AM

Page

1. CITY COUNCIL GOAL SETTING MEETING

This meeting is occurring off-site.

To listen to the meeting audio:
Call (253) 215-8782
and enter the meeting passcode: 890 3705 4195

2. OPENING REMARKS

- Reflections on 2021
- Draft Vision Statement

3. SANDY COMMUNITY CAMPUS NEXT STEPS

4. HIGHWAY 26 BYPASS NEXT STEPS

5. UPDATE ON CURRENT STATUS OF 2021-2022 CITY COUNCIL GOALS

6. ADJOURN

Staff Report

Meeting Date: March 5, 2022

From Rochelle Anderholm-Parsch, Parks and Recreation Director

SUBJECT: Sandy Community Campus Next Steps

DECISION TO BE MADE:

There are four main topics staff have identified for this goal setting meeting:

1. Review and understand the recommendations made by the Pool Exploratory Task Force (PETF).
2. Agreement on whether staff should drain the pool.
3. Explain and discuss the structure and process for the next phase of Community Campus planning, including the Technical Advisory Committee.
    a. Agreement on whether to move forward with park improvements on the site.
4. Discuss whether the Council is inclined to recommend that the SURA Board commits $10 million in future Urban Renewal revenue bonds for the campus project.

TOPIC 1: Review and understand the recommendations made by the Pool Exploratory Task Force (PETF)

Background

The PETF (which included six residents along with Councilors Hokanson, Walker, and Exner) met from July through December 2021 to develop a recommended path forward for the aquatic center. They put in a tremendous amount of work, for which we are incredibly grateful. Their final report is attached to this staff report for the Council's review.

Two main points to take away from the report:

- Repairing and reopening the aquatic center as currently configured is not feasible. Substantial funds would be required to address critical needs related to pool infrastructure and building systems before the public could be served. The current facility also does not provide a dedicated recreation pool. Certain aspects of the building's architecture make comprehensive renovation of the structure difficult and expensive.

- The PETF recommends constructing a new aquatic center elsewhere on the Campus property. The report includes details on desired facility features, as well as rough estimates of capital and operations costs. While not discussed at great length in the report, the consultant team determined that an advantageous strategy would be to construct an aquatic center addition to the middle school annex building (bunker building), which itself could be leveraged into a new community center space in the future. The Council was presented with this possibility during its November 1, 2021, meeting. Graphic renderings of the concept are linked starting at page 31 of the attachment to the minutes from that meeting.

Discussion

- Does the Council have any questions about the PETF report and recommendations?

TOPIC 2: Agreement on whether to drain the pool

Background

Based on the work and findings in the "Sandy PETF Final Report | January 2022" alterations to the existing aquatic facility would be challenging and costly. Furthermore, the facility requires a full mechanical, electrical and plumbing replacement, major envelope repairs, abatement, and overall updating to interior finishes.

There was a consensus by the PETF that constructing a new aquatic facility somewhere else on the campus site was the preferred choice. Based on these findings, staff suggests the most fiscally responsible choice is to drain the pool. This will save on expenses that could otherwise be allocated to additional City operations, programs, or services

Cost and Funding

The 2021-2023 Aquatic/Recreation Center Fund adopted budget is $336,624. Fiscal activity, to date, is approximately $100,297. This includes expenses such as: salaries, pool chemicals, repairs and maintenance, and utilities. The largest expenses are $15,570 for utilities, $26,838 for insurance, and contractual services (Opsis), $40,150.

Approximate savings. Note: there are various expenditures from this account allocated to SandyNet and the Annex Building.

$20,000 / utilities
$2,000 / chemicals
$2,000 / equipment rental
$40,000 / contingency ($40,000 to cover Opsis)

$36,500 / salaries

Total estimated savings: $100,500

Decision Point

- Does the Council concur that the pool should be drained?

Next Steps

- If the Council agrees, staff will proceed with draining the pool and retiring mechanical systems in the facility.

TOPIC 3: Explain and discuss the structure and process for the next phase of Community Campus planning, including the Technical Advisory Committee.

SUBTOPIC 3A: Agreement on whether to move forward with park improvements on the site.

Background

To meet Council goal 8 (a), “Appoint a committee to guide the next steps for the Community Campus and Aquatics”, and 8 (c), Develop a plan for the community Campus, staff has developed a cohesive process that builds a committee to guide the next phase of the Community Campus project.

The “Community Campus Context Process Chart,” provided in the attachments, illustrates an organized way to move forward all three aspects of the Community Campus project: aquatics, recreation, and park improvements. Or, as often referred to, the “three legs of the stool.”

The Context Chart shows the creation of a Technical Advisory Committee (TAC) consisting of the Community Campus Subcommittee (CCS), staff, and a consultant. Serving as a technically focused project group, the TAC will fulfill its role through the duration of project. The CCS will provide oversight and input as to who should serve on the TAC, and the City Manager will establish the TAC and communicate it to Council.

Developing a TAC underscores the importance and involvement of formal boards as well as informal focus groups. The TAC will ensure a robust public engagement process. Furthermore, the TAC will assist in data gathering, and provide input to help keep the project with budgetary and design scope.

Staff are prepared are move forward with this process. This work includes creating a Request for Proposal (RFP) to solicit and hire a consultant to concurrently design a concept that incorporates the "three legs of the stool."

Proposed Final deliverables would include:

(1) A conceptual design for a community and recreation center *(bond ready rendering/schematics).*
(2) Design development, construction drawings, bid and build documents for park improvements and infrastructure *(shovel ready park project).*

As it relates to Subtopic 3A, if it is the will of Council, staff will incorporate into the RFP the work to design, bid, and build the park development phase at the Community Campus site. This could potentially involve a request for usage of the $3 million remaining in SURA cash and would involve identification of additional funding sources such as SDC and grants.

<u>Decision Point</u>

- Does the Council support the process as illustrated in the "Community Campus Context Process Chart"
- Is there support to move forward with the park improvements on the site?

<u>Next Steps</u>

- If council agrees, staff will create and RFP that incorporates final deliverables (1) & (2).
    (1) A conceptual design for a community and recreation center *(bond ready rendering/schematics).*
    (2) Design development, construction drawings, bid and build documents for park improvements and infrastructure *(shovel ready park project).*

<u>TOPIC 4</u>: Discuss whether the Council is inclined to recommend that the SURA Board commit $10 million in future Urban Renewal revenue bonds for the campus project.

<u>Background</u>

Over the course of several meetings Opsis, CCS and the PETF reviewed preliminary capital costs to build an aquatic and community center. Opsis's initial numbers were projected at around $50 million. The CCS discussed the implications of a $50 million general obligation bond. After further discussion, the CCS felt that a $25-$35 million general obligation bond was the maximum. The CCS also discussed the ability to bond an additional $10 million in urban renewal revenue bonds from the Sandy Urban Renewal Agency to help fund the capital project costs of building the aquatic and recreation portions of the community campus project. A consensus recommendation by Council that SURA should commit $10 million to the community campus project would be used to leverage other available funds such as SDC's, grants, and a general obligation bond.

As the project prepares to move into the next phase of development and a potential bond campaign, the following priorities have been identified:

- Involve the public in the next level of the study to determine future facility development.
- Develop a technical advisory committee (TAC) to continue to provide input into future phases of Community Campus planning.
- Establish preliminary design for the recreation pool and amenities
- Refine the concept plan for the preferred option.
- Refine the operations estimates.
- Update the cost estimate based on a refined conceptual plan of the whole campus.
- Provide visual collateral for a potential bond campaign, including renderings depicting the preferred option
- Cohesively design a Community Camps concept that includes not only the Community Aquatic and Recreation Center, but also park improvements.
- Refine and right size the facilities to meet the proposed funding goals.
- Define and refine funding goals

Decision Point

- Is the Council inclined to support a SURA commitment of $10 million in revenue bonds for the campus project?

Next Steps

- If the Council agrees, staff will use this budgetary guideline and support as parameters moving forward with refinement of the Community Campus concept. Staff will continue to identify alternative funding sources for the park improvement side.

LIST OF ATTACHMENTS/EXHIBITS:

1. PETF Final Report
2. Process Context Chart
3. General Obligation Bond Calculations

SANDY OREGON

Sandy Pool Exploratory Task Force

FINAL REPORT | JANUARY 2022

City of Sandy
39250 Pioneer Blvd.
Sandy, OR 97055
ci.sandy.or.us

Report prepared by:

Opsis Architecture
920 NW 17th Avenue
Portland, OR 97209
opsisarch.com

Acknowledgements

POOL EXPLORATORY TASK FORCE

Participants
Kacie Bund (Chair)
Meagan Lancaster (Vice Chair)
Grant Hayball
Jan Sharman
Blake Smith
Mark Smith
Councilor Don Hokanson
Councilor Kathleen Walker
Councilor Carl Exner

CITY OF SANDY

Staff
Jeff Aprati, Assistant to the City Manager / City Recorder
Rochelle Anderholm-Parsh, Parks and Recreation Director
Jordan Wheeler, City Manager

PLANNING TEAM

Opsis Architecture
Jim Kalvelage, Partner & Planner
Liz Manser, Project Manager

Ballard*King & Associates (Operations Plan)
Ken Ballard, Partner

ACC Cost Consultants (Cost Estimating)
McCabe Karcher, Cost Estimator

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SANDY POOL EXPLORATORY TASK FORCE

Executive Summary

The Sandy Pool Exploratory Task Force study was a renewed planning effort focused on assessing the City's current and future aquatic program needs and envisioning the most cost effective and functional facility to meet those needs. Options were explored to address the physical and program deficiencies of the outdated Olin Y. Bignall Aquatic Center by either repairing and reopening the facility, or by pursuing one of the following options: 1) renovating the existing natatorium, 2) renovating the natatorium and constructing an addition, or 3) constructing a new aquatic facility. The primary focus of this effort was to evaluate aquatics program spaces, though additional indoor fitness / recreation and community spaces may be considered by the City in more detail in the future.

In August 2021, the Pool Exploratory Task Force (PETF) began its work by evaluating the option of repairing and reopening the aquatic center as currently configured. Due to costly critical repairs required for both the pool systems and building systems, the PETF determined that such an approach would be infeasible. Thus, a process was undertaken to determine which of the remaining three options would be preferable.

The PETF proceeded to assess the community's aquatic needs and research other benchmark indoor and outdoor aquatic facilities in other similar rural communities throughout Oregon, with the intention of developing a proposal for a safe, affordable, and accessible place for community members to swim and learn vital water safety skills. Preliminary space requirement figures were established, conceptual layout schematics were created, and initial capital and operations cost estimates were calculated with the assistance of contracted consultants.

After detailed analysis and evaluation, the PETF recommended against renovating and/or expanding the existing Aquatic Center, in favor of developing a new natatorium with a 3,500 square foot warm water recreation pool and a minimum 6-lane 25-yard competition pool, with a preference for an 8-lane 25-yard competition pool.

Given this recommendation, it may be possible for the City to leverage the existing Middle School Annex Building to develop a combined aquatics and community center facility within a compact and efficient layout.

This report includes the PETF recommendations for the space program, conceptual site and building layouts, and preliminary capital cost and operational cost estimates for the aquatic facility.

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SANDY POOL EXPLORATORY TASK FORCE

Planning Process

SUMMARY

The PETF was established by the Sandy City Council to identify the community's aquatic space program needs and evaluate aquatic layout options, taking into consideration estimated project costs, operational costs, and aquatic programming opportunities.

Beginning in July 2021, an aquatic needs assessment effort was initially led by the City of Sandy staff working directly with the PETF. The effort was later expanded to include facilitation and planning support from Opsis Architecture and Ballard*King Associates from September 2021 to December 2021. Project steering and guidance was provided by the Community Campus Subcommittee (CCS; comprised of Councilors Hokanson, Walker, and Exner), including consideration of possible integration of other facility program needs such as recreation and community spaces and connections to future park developments.

At the beginning of this process, the PETF established project guiding principles to help guide discussion and assist with the final evaluation process. These principles, listed below, informed the development of a final evaluation matrix used to evaluate aquatic options.

AQUATIC GUIDING PRINCIPLES

- Accommodate Lap and Recreation Swim Programs
- Provide Operationally Efficient Layout
- Meet Cost Recovery Goals
- Develop Cost Effective Parking Layout
- Integrate Convenient Service Access to Aquatic Mechanical
- Maximize Value of Investment
- Work Within Budget Constraints
- Compelling Vision for Successful Bond Initiative

OTHER PROJECT CONSIDERATIONS

- Integrate Potential Fitness and Community Spaces
- Potential Public Walkway to Park
- Potential Addition of Park Amenity

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Space Program Needs

AQUATIC SPACE PROGRAM DEVELOPMENT

The preliminary proposed aquatic program was based upon a list of desired building program elements, pool amenities, and potential aquatic center programming developed by the PETF in August of 2021. The following list of potential aquatic elements was evaluated and prioritized, and subsequently used as the basis for the proposed aquatic space program.

DESIRED AQUATIC ELEMENTS

RECREATION POOL	COMPETITION POOL	GENERAL
• Lazy River • Slides • Kid's Pool • Hydrotherapy • Inflatables	• Swim team practice & meets • Bleachers • Water Polo • Diving Board	• Sauna • Hot Tub • Party rental rooms • Restrooms / locker rooms • Universial Changing rooms • Storage for long-term renters • Aquatic equipment storage • Lifeguard / office space • Lobby w/ seating / pool views • Snack bar / vendors

RECREATION POOL SIZE CONSIDERATION

The combination of shallow water and warm temperature in a recreation pool provides opportunities for a wide range of community programming including water fitness classes, swimming lessons, therapy, and interactive water play. At 3,500 square feet (SF), the proposed recreation size pool could accomodate desired amenities such as zero depth entry, a current channel, and interactive water play elements such as a water slide, fountains, rock climbing or ropes. Specific recreation pool features will be prioritized and refined in the next phase of design. This proposed recreation pool area is comparable to other local recreation pool sizes such as the Madras Aquatic Center, Portland Southwest Community Center, Firstenburg Community Center, and the Portland Mt Scott Community Center.

COMPETITION POOL SIZE CONSIDERATION

The size of the competition pool was discussed at length with the PETF, city staff, and design team, in order to determine an appropriate size to serve a broad range of the Sandy community needs. The PETF base recommendation is a 6 lane 25-yard, deep/deep competitive pool, however, the PETF strongly recommends consideration of an 8-lane 25-yard, deep/deep pool in the next phase of this study. An 8-lane pool offers expanded programming benefits for high school swim meets and water polo, as well as opportunities for simultaneous programming such as additional lap swimming, water exercise, and fitness classes. The capital and operational cost increases associated with a larger competition pool are referenced to the right.

COMPETITION POOL SIZE COMPARISON

	6 LAP LANES X 25 YARDS	8 LAP LANES X 25 YARDS	DIFFERENCE
POOL AREA	3,150 SF	4,350 SF	1,200 SF
CAPITAL COSTS			**DIFFERENCE**
Preliminary Pool Capital Cost (WTI)[1]	$ 1,395,000	$ 1,770,000	$ 375,000
Increased Building Area Capital Costs[2]			$ 700,000
Total Increase in Capital Costs			$ 1,075,000
OPERATIONAL COSTS			**DIFFERENCE**
Approx. Competitive Pool Operational Expenses per Year	($ 500,000)	($ 630,000)	($ 130,000)
Approx. Competitive Pool Revenue per Year	$ 200,000	$ 230,000	$ 30,000
Approx. Yearly Operational Subsidy	($ 300,000)	($ 400,000)	($ 100,000)

1. Preliminary Pool Capital costs include the pool vessel, piping and filtration/treatment equipment. They do not include any additional pool mechanical costs. Estimate includes 45% markups including escalation to 2023.
2. The capital costs are based on a potential 1,200 SF addition required to house an 8-lane competition pool. Estimate is based off a cost of $400/SF + 45% Markups, including escalation to 2023 (figures are rounded).

COMMUNITY & RECREATION PROGRAM CONSIDERATIONS

In order to fully evaluate the aquatic center options, consideration was given to how aquatic spaces could possibly integrate into a comprehensive and operationally efficient facility that incorporates community and recreation aspects. Opsis leveraged its past experience with similar community center programming to study the feasibility of a combined facility. More detailed analysis and additional stakeholder input will need to be performed by the City in the future to develop a community and recreation program recommendation.

PROPOSED AQUATIC SPACE PROGRAM

The final proposed aquatic program includes amenities such as a competition pool, recreation pool, spa, spectator seating, and a party room, along with additional support spaces as required to provide a fully functional aquatic center, including administration, storage, locker rooms, and reception spaces. It was determined that a sauna could potentially be considered at a later phase in the context of potential community / recreation dryland programming.

The projected size of the identified program areas is reflective of typical aquatic center spaces along with proportionally sized support spaces, resulting in a total assignable square footage of 24,200 net square feet, and a projected total aquatics program area of 30,250 square feet. This size target assisted in the development and evaluation of the aquatic center test fit options.

AQUATIC CENTER

A. Operations - Building Support		
A.01	Entrance / Lobby	900
A.02	Reception / Access Control / Registration	500
A.04	Concessions / Vending	100
A.05	General Locker Rooms (2 @ 1400 sf)	2800
A.06	Universal Changing Vestibule	150
A.07	Universal Changing Rooms (4 @ 90sf)	360
A.09	General Building Storage	300
A.10	Maintenance Room	400
	Subtotal: Building Support Spaces	**5,510 nsf**
B. Aquatic Spaces		
B.01	Competition Pool - 6 lane 25-Yard (water 3,150 sf / deck 2,850 sf)	6000
B.02	Spectator Seating - 200 seats	1200
B.03	Recreation Pool (water 3,500 sf / deck 4,100 sf)	7600
B.04	Spa / Whirlpool	250
B.05	Sauna	NIC
B.06	Aquatic Offices (2@ 120 SF)	240
B.07	Guard Room	300
B.08	Lifeguard Changing / Breakroom	100
B.09	First Aid Room	NIC
B.10	Pool Storage	400
B.11	Pool Mechanical & Heater Rooms	2000
	Subtotal: Aquatic Spaces	**18,090 nsf**
C. Community Spaces		
C.01	Birthday Party / Meeting Room (divisible)	600
	Subtotal: Community Spaces	**600 sf**
		24,200 nsf
	25% grossing factor	**6,050 sf**
		30,250 gsf

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SANDY POOL EXPLORATORY TASK FORCE

Concept Design Options

PRELIMINARY AQUATIC CENTER CONCEPT DESIGN OPTIONS

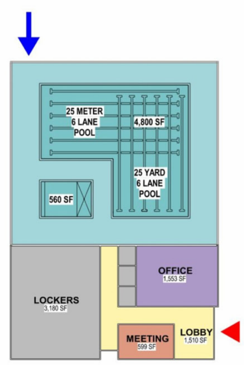
Four options were presented to the PETF at its first meeting – examining a full range of potential scenarios for the natatorium:

Option 1: Utilize the existing natatorium with existing pool tanks.

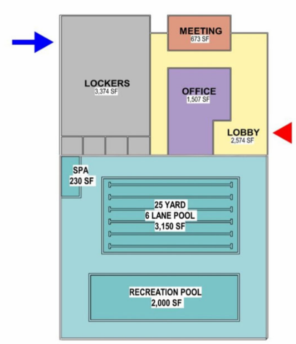
Option 2A: Utilize existing natatorium with a modified lap pool (no addition). This option provided a small, separate 2,000 SF recreation pool.
Option 2B: Utilize existing natatorium with a modified lap pool, including an addition. The addition would accommodate a larger, separate 3,500 SF recreation pool.
Option 3A: Create a new natatorium with both a 6 lane, 25 yard lap pool and 3,500 SF recreation pool.

While Option 1 utilizes the existing natatorium and pool vessel configuration, it does not provide a separate recreation pool as desired by the PETF for more robust aquatics programming or a prominent connection between the natatorium space and Pleasant Street. The PETF therefore decided not to advance this option.

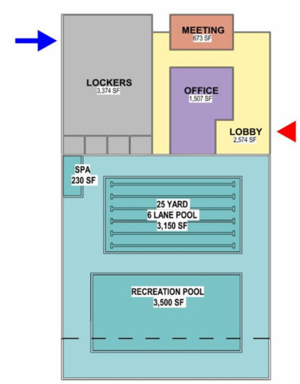
OPTION 1



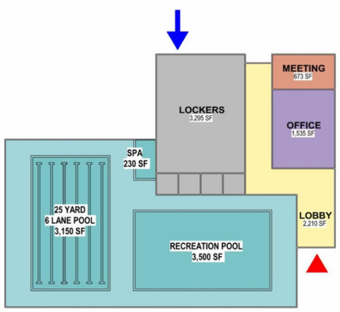
OPTION 2A



OPTION 2B



OPTION 3A



PRELIMIINARY AQUATIC LAYOUT OPTIONS

By moving the support space to the north side of the building, Option 2A provides a better connection to Pleasant Street. Option 2A also includes a stand-alone recreation pool, however the new recreation pool was limited in size due to the existing natatorium enclosure (hence the task force's decision not to advance this option). Option 2B addresses the size concern by expanding the existing natatorium enclosure to provide a larger recreation pool.

Option 3A assumes a new natatorium. By locating the natatorium completely in a new structure, Option 3A allows more flexibility for efficient shaping of the pools and better program adjacencies.

The PETF decided to move forward with the development of two preferred concept design options: Option 2B (existing natatorium with an addition) and Option 3A (new natatorium).

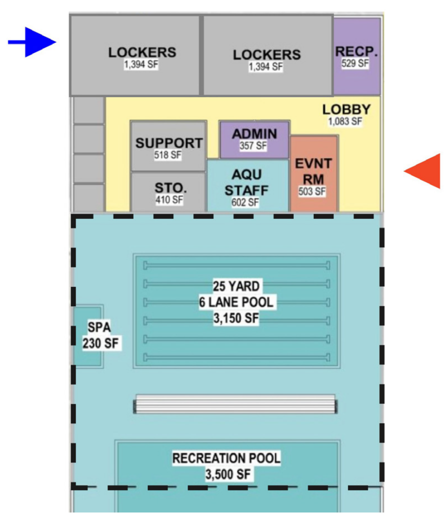
PREFERRED AQUATIC CENTER CONCEPT DESIGN OPTIONS

After further developing the two preferred options, the Design Team produced layout concepts (shown below) that both provide a central lobby space with direct connection to administration/reception areas, as well as party room and aquatics offices with direct adjacencies and strong sightlines to the pool deck.

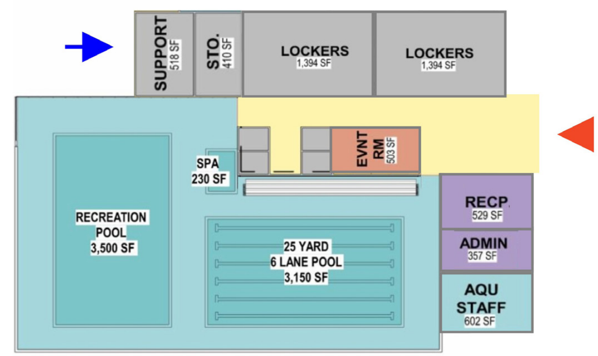
Option 2B's recreation pool lacks direct adjacency to locker rooms, and has potential sightline issues created by the location of spectator seating for the competition pool.

Option 3A presents the possibility of constructing a new aquitic center as an addition to the Middle School Annex Building to leverage the reduced cost of renovation and minimize new construction. Locker rooms provide direct access adjacent to the recreation pool, and the 'L' shaped configuration allows direct views from the aquatics office and the spectator seating.

OPTION 2B



OPTION 3A



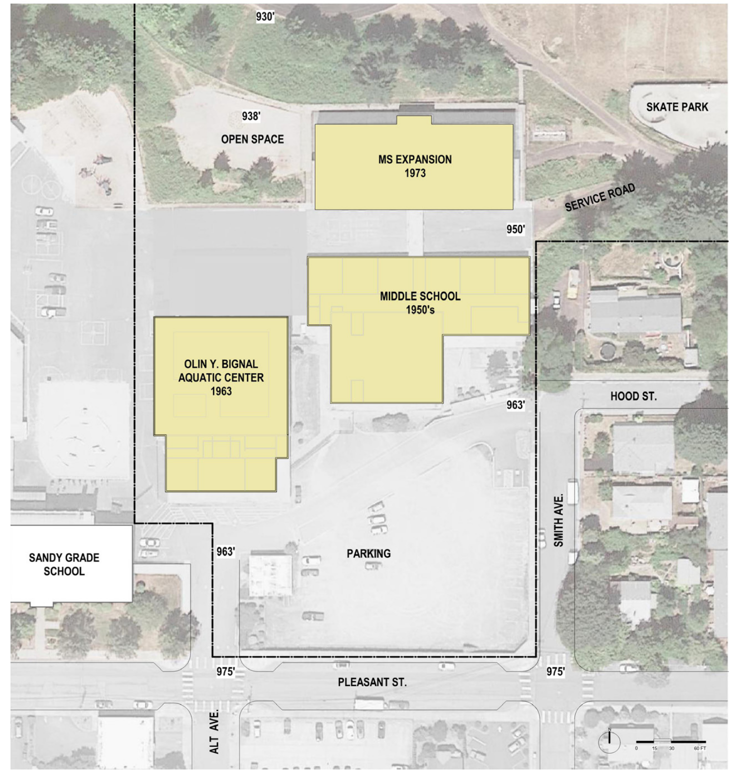
PREFERRED AQUATIC LAYOUT OPTIONS

CONCEPTUAL SITE LAYOUT & EXISTING BUILDING CONSIDERATIONS

At subsequent meetings, layouts for both options were shown in more detail, and included consideration of the Community Campus site and potential integration with community/recreation center program elements. These site considerations include parking, vehicular and pedestrian access, as well as an acknowledgement of the concepts presented in the 2018 Pleasant St Masterplan (PSMP), and the Sandy Parks & Trails Master Plan.

Both aquatic layout options aimed to leverage existing buildings on site. The two buildings identified for potential re-use were the natatorium of the 1963 Olin Y. Bignall Aquatic Center and the 1973 middle school annex building. The third existing building, the 1950's middle school, is located in the center of the site, limiting site access and connectivity. The middle school building requires extensive structural, mechanical, electrical and plumbing upgrades, and both site options operate under the assumption that the existing middle school building will be demolished to create better site access and more efficient parking layouts.

Preliminary assessments of these buildings were completed during the '2018 Masterplan Facilities Assessment', the '2020 City of Sandy Facilities Assessment', and the 2021 'Memo to Task Force on Repair Costs'. The design team took these reports into consideration when developing the preliminary cost model and evaluating the viability of the aquatic options.



EXISTING COMMUNITY CAMPUS STRUCTURES

Existing Aquatic Center
Alterations to the existing aquatic center are inherently challenging because of the construction methods used and the state of the facility. The existing walls consist of a compromised, hybrid concrete masonry unit (CMU) and wood structure. In order to expand the natatorium to the south as outlined in Option 2B, a major structural reconfiguration of the south wall is required to provide a clear span support across the new recreation pool. Additionally, the building requires a full mechanical, electrical and plumbing (MEP) replacement, major envelope repairs, abatement, and overall updating to interior finishes.

Moving forward, if the aquatic center and middle school are demolished, they should be surveyed for potential salvage items such as wood beams that could be repurposed in the new aquatic center.

Middle School Annex

The Middle School (MS) Annex Building provides a more robust starting point for a major renovation and addition. Seismically, the use and occupancy hazard levels are assumed to be unchanged when converting from a K-12 educational use to a community space at the MS Annex Building, indicating that seismic upgrades would be voluntary.

The building was originally constructed in 1973. However, the method of construction for this building and its modest size provide an opportunity to utilize the building without triggering mandatory strengthening of gravity or lateral structural elements. While the building code references a prescriptive limitation for the modification of gravity resisting structures to 5% and lateral force resisting structure to 10%, the robustness of the existing building leads us to believe building modifications are possible even if they affect more than 5% and 10% of the structure without mandating strengthening.

It should be noted, if the occupancy change should increase the potential hazard to life safety in the building, added structural strengthening may be required. Lastly, the CMU or gyp clad exterior walls on the north, west and east elevations are non-structural in nature. Removing those walls to create more views, open rooms, etc. will not affect the gravity or lateral force resisting components of the existing structure.

The Middle School Annex building will require major MEP upgrades as it is currently tied to the existing Middle School boiler. As with the existing aquatic center, it will require abatement and interior finish upgrades.

Taking the existing conditions of both buildings into account a rough assesment of the 'total building value' of each building was developed. This 'total building value' equates to a rough order of magintude savings over the cost of new construction. The better condition and larger square footage of the MS Annex building equated to a larger overall 'total building value' as shown below.

ADDITIONAL SITE CONSIDERATIONS

An approximately 30,000 SF aquatic center would require approximately 120 parking spaces according to the Sandy Municipal Code. Additional project square footage added by potential community center programming would likely add significantly to the required parking count.

Service access to the pool mechanical systems will be a high priority. Option 2B relies on the access on the west side of the site provided by a ROW easement. Option 3A provides direct service access to a service court from SE Meinig Ave near the skate park entry. Moving into the next phase, the adjacencies of the service access, pool mechanical room, and natatorium should be reviewed.

Option 3A creates a strong connection between the natatorium and the park to the north. It also creates an opportunity for a linear, north/south connection between Pleasant Street and the park.

TOTAL EXISTING BUILDING 'VALUE'

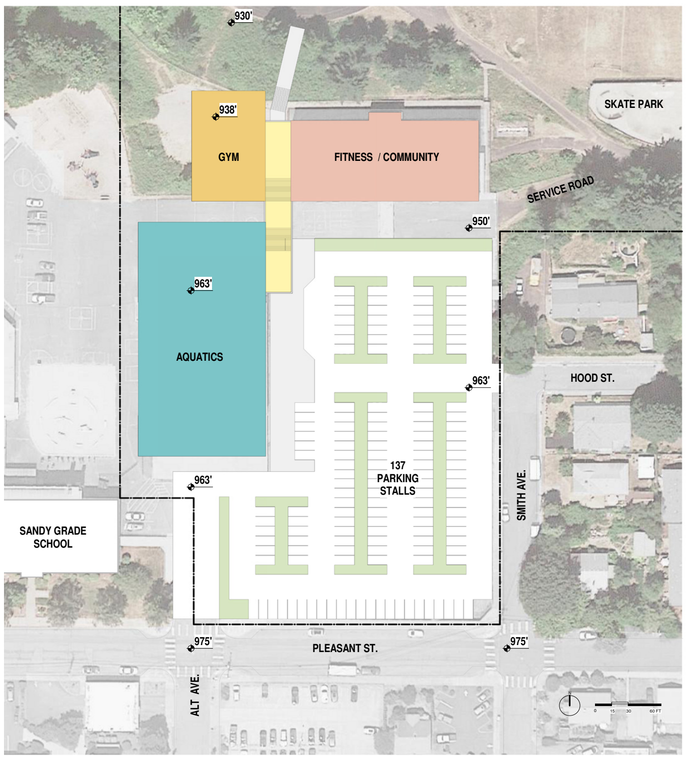
MIDDLE SCHOOL ANNEX BUILDING			OLIN Y. BIGNALL AQUATIC CENTER		
Existing 'building value'	=	$ 225 - $ 300/SF	Existing 'building value'	=	$ 75 - $ 150/SF
Existing building SF	=	26,276 SF	Existing building SF	=	17, 298 SF
Estimated 'total building value'	=	$ 5.91M - $ 7.88 M	Estimated 'total building value'	=	$ 1.29M - $ 2.59M

FACILITY DESIGN ATTRIBUTES

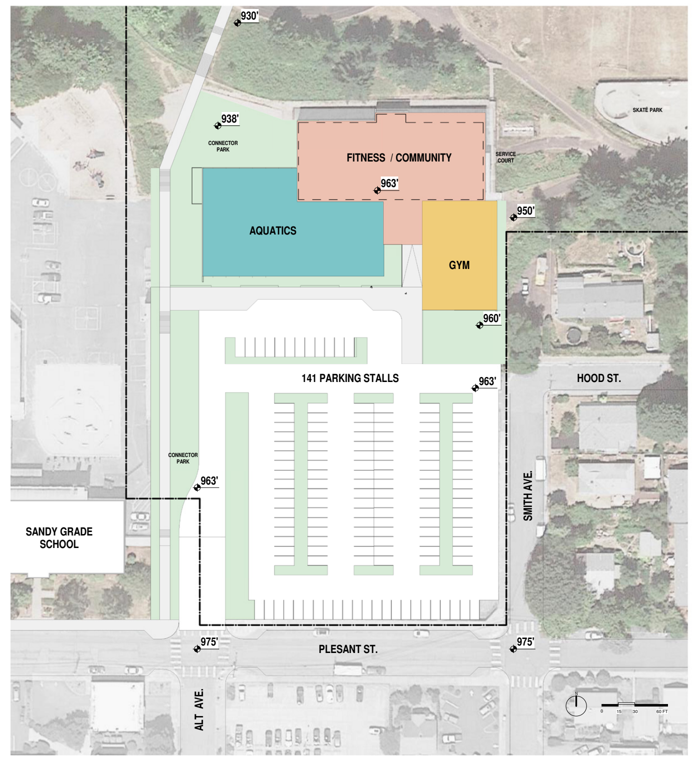
The PETF worked to identify a list of desired design attributes for the new facility. This list helps to identify design priorities that should be considered as the project moves into the next phase:

- Viewing windows into pools
- Indoor / outdoor connections
- Operable windows / natural ventilation
- Natural daylight / views
- Covered entrance / drop-off area
- Universal accessibility
- Covid/ Health design strategies
- Smart vestibule design
- Good Acoustics
- Energy Efficient
- Smart Filtration Systems

OPTION 2B CONCEPTUAL SITE LAYOUT



OPTION 3A CONCEPTUAL SITE LAYOUT



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Preliminary Cost Estimates

AQUATIC CENTER CAPITAL COSTS

Preliminary, rough order of magnitude (ROM) project cost estimates were developed with Architectural Cost Consultants for the Aquatic Center. The total project cost summary includes both construction cost, indirect construction costs, and accounts for escalation to late 2023. Both project costs include a healthy contingency to account for the unknowns at this early phase of estimating and design.

These costs were developed utilizing the layouts for two preferred Aquatic Center Options (2B and 3A). Independent costs per square foot were developed for renovation and addition areas for both the existing aquatic center and the middle school annex building, and included site considerations, demolition, and abatement costs. These costs will need to be refined in the future, and can be expanded to account for additional potential recreation and community center elements.

AQUATIC CENTER CAPITAL COST (ROUGH ORDER OF MAGNITUDE)	OPTION 2B		OPTION 3A	
Building Costs	$	22.69M	$	17.58M
Site Costs	$	4.56M	$	2.90M
Construction Cost	**$**	**27.25M**	**$**	**20.48M**
Indirect Project Costs (30%)	$	8.18M	$	6.14M
Total Project Cost	**$**	**35.43M**	**$**	**26.62M**

Building Costs: Includes Building Construction, Escalation, Design Contingencies.
Site Costs: Demolition, Abatement, site development (utilities, grading, landscape, parking, etc.).
Indirect Project Costs: Owner's Construction Contingency, Permitting, Testing, Fixtures, Furnishings & Equipment, Architect & Engineering Fees, Owners Representative, Legal Fees, and Commissioning.
Escalated to a costruction start date of late 2023.

AQUATIC CENTER OPERATIONS

It is important to realize that it is virtually impossible for indoor aquatic centers to cover their cost of operations through fees generated by the facility. The size of the operational loss (operating expenses minus earned revenue) varies by a number of factors:

Type of Pool – competitive pools operate at a higher loss than a recreational pool. The larger the competitive pool (number of lanes and length of pool) the higher the loss. Recreational pools usually have a higher fee for use, attract more users and support a wider range of programs but still have an annual loss.

Fees that are Charged – a more aggressive fee structure for admission to the pool, for programs and services and rentals of a competitive pool will have a significant impact on the size of the operational loss.

Cost of Goods and Services – the compensation level for staff (especially lifeguards) and the cost of utilities drives the overall cost of operation. As these two aspects continue to increase in cost, the operational loss will grow.

Presence of Other Amenities – if other non-aquatic amenities are added to a center, especially fitness related spaces, the operational loss associated with the pool can be lowered.

The table outlines a rough order of magnitude estimate of the Aquatic Center's yearly operational costs and necessary subsidy.

These figures are based on the aquatics space program elements outlined above, including a 6 lane 25-yard, deep/deep competitive pool and a 3,500 sf recreation pool. As outlined above in the 'Competition Pool Size Consideration' section, adding two lap lanes to the competition pool would increase the yearly expenses by approximately $130,000, while increasing the yearly revenue by approximately $30,000. It may be possible to decrease the necessary subsidy by leveraging technologies such as ultraviolet filtration, solar power infrastructure, and energy efficient mechanical systems, which could potentially lead to opportunities to secure grant funding.

As with the capital costs, operational costs will be further refined in future phases of this planning effort.

AQUATIC CENTER OPERATIONAL COST (ROUGH ORDER OF MAGNITUDE)

	Recreation	Competition	Total
Expenses	$ 700,000	$ 500,000	$ 1,200,000
Revenue	$ 500,000	$ 200,000	$ 700,000
Subsidy	$ (200,000)	$ (300,000)	$ (500,000)

SANDY POOL EXPLORATORY TASK FORCE

Recommendations

EVALUATION

Utilizing the guiding principles developed with the PETF, a final decision matrix was developed, outlining the evaluation criteria to lead the decision-making process.

FINAL RECOMMENDATION

It was determined that Option 2B had increased construction and operational costs and created more unknowns during the construction and demolition process. Option 3A allowed for a more compact and operationally efficient layout, as well as a lower overall construction and project cost. The Task Force therefore recommended Option 3A.

EVALUATION MATRIX	OPTION 2B	OPTION 3A
Aquatics Construction Cost	$27.25M Construction Cost	$20.48M Construction Cost
Aquatics Operational Cost*		
Operationally Efficient Layout	Disconnected Aquatics & Community Programs	Compact Layout-efficient net to gross
Accommodate Competition & Recreation Swim Programs	Includes Competition Pool & Recreation Pool	Includes Competition Pool & Recreation Pool
Compelling Vision for Succesful Bond Initiative		
Efficient Parking Layout	Requires retaining walls	
Aquatic/Community Center Integration	Requires complicated connection or additional staffing	Creates a wholistic campus
Integration with Park		Allows greenway park connector from Pleasant St.
Aquatic Service Access	Breezeway connection creates difficult service access to Aquatic Supper areas - utilize easement	

for additional aquatics operational information, reference page 6

high medium low

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SANDY POOL EXPLORATORY TASK FORCE

Next Steps

As the project prepares to move into the next phase of development and a potential bond campaign, the following priorities have been identified:

- Involve the public in the next level of the study to determine future facility development.
- Continue to provide task force input into future phases of Community Campus planning.
- Refine and right size the facilities to meet the proposed funding goals.
- Establish preliminary design for the recreation pool and amenities
- Refine the concept plan for the preferred option.
- Refine the operations estimates
- Update the cost estimate based on a refined conceptual plan of the whole campus.
- Provide visual collateral for a potential bond campaign, including renderings depicting the preferred option.

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SANDY POOL EXPLORATORY TASK FORCE

Appendix

August 4, 2021

Re: Repair Costs for Existing Aquatic Center

Pool Exploratory Task Force Members:

As you know, Brody Anderson cited a cost range of $1.3 to $1.5 million to address the critical pool system infrastructure (piping and filtration, gutter system, expansion joint repair, etc.) in the existing aquatic center (see Attachments 1 and 2). It's important to note that this number does not account for a variety of other issues that he was not prepared to cite prices for, but that would be necessary to fix if the doors were going to be opened. These included things like HVAC system, plumbing system, ADA issues, etc.

I was recently informed that many of these additional costs were estimated in a follow-up analysis conducted by OPSIS back in September 2019 (see Attachment 3).

As you can see, this estimate is for a renovation of the existing facility intended to last for 15-20 years. That said, most of the items listed would be essential to fix, at least to some extent, before allowing the public back in the building (mechanical / electrical / plumbing (including HVAC), seismic upgrades, etc). While I'm certainly not an expert, it seems likely to me that we're talking about a cost level of at least $3.5 million before it would be possible to open the doors, <u>and that's before accounting for contingencies and soft costs</u>.

I look forward to hearing from the group whether, in your judgment, Option 4 from our bylaws (temporarily re-open the existing pool and transition to new construction) is financially feasible and a prudent use of funds.

Please let me know if you have any questions.

Best,

Jeff Aprati

SANDY OREGON

ATTACHMENT 1

Jeff Aprati <japrati@ci.sandy.or.us>

Follow-up to voicemail - Sandy Aquatic Center

Brody Anderson <Brody@andersonpoolworks.com> Tue, Jul 20, 2021 at 5:14 PM
To: "japrati@ci.sandy.or.us" <japrati@ci.sandy.or.us>

Sandy Aquatic Center report:

Jeff,

Attached are the photos from yesterday's walk through at the aquatic facility.

I will start with the pool structure: the swimming pool shell looks to be a poured in place structure with several expansion joints in need of repair/replacement and the existing expansion joint material is a product that is no longer EPA acceptable due to cancer causing materials.

The surge gutter lip shows signs of reinforcement steel corrosion/cancer and will need to be rebuilt/replaced. The surge gutter system is bare concrete and no waterproofing is in place and therefore water is migrating through the concrete and weakening the concrete structure and reinforcing steel (evidenced by cracking on the underside of the gutter in the mechanical room area where water is dripping and calcium is leeching through the cracks and spalling areas of concrete). The leaking has been happening for a long period of time (evidence is long stalactites of calcium dripping from the leak points). This brings in to question the structural integrity of the pool gutter structure.

The pool return lines appear to be iron piping. The rust debris around each floor inlet would suggest all inlet and suction outlet piping is ductile iron and will need replacement prior to opening.

The viewing port window shows evidence of seal failure: debris growing around the gasket seal. It would be recommended that the viewing window be removed as soon as possible mitigating catastrophic failure.

The current water level of the swimming pool is well below normal operating level. The current maintenance person indicated that they were not adding water more than once per week (possible minor evaporative loss) but without the pool operating at full capacity, there is no way to determine if there exists a 'leak' of the pool structure.

The wading pool currently shares filtration system with the lap swim pool violating OHD rules for wading pools. The options would be to either add a full filtration system for the wading pool or complete removal of the wading pool.

The pool filtration system and piping is mostly ductile iron with a mix of some PVC schedule 40 piping. Maintenance staff indicated that most of the valving is rusted closed or not able to be turned. The chemical automation system is offline and without full systems operational, it cannot be determined if the system is viable. The filter pit is archaic and would need to be updated prior to systems being brought back online. The system boiler is old (1960's) and needs to be replaced prior to system operation for the safety of the building and patrons.

Overall, the pool shell, filtration system and piping will all need to be upgraded to like new standards prior to pool opening or operation. While there have been minor upgrades prior to the pool shutting down, there are too many deficiencies evident to suggest that the pool reopen to the public without extensive upgrades.

The estimated cost associated with repairing the deficiencies and to upgrade the pool to OHD standards: **$1.3-$1.5M**
These numbers do not address the building, HVAC, locker rooms, lobby, decking, ADA access.

Brody Anderson| Vice President

Anderson Poolworks

Oregon | Headquarters

9500 SW Boeckman Road, Wilsonville, Oregon 97070

Cell (503) 969-9405 | **Office** (503) 625-5628

Washington

1400 112th Avenue SE, Suite 100 Bellevue, WA 98004-6901

(425) 278-6055

Hawaii

947 S. Kihei Rd., Kihei, HI 96753

(808) 725-3534

OR 125440 | WA ANDERP*903RH | HI CT-36187 | ID RCE-47977 | MT 54314 | AK 38145

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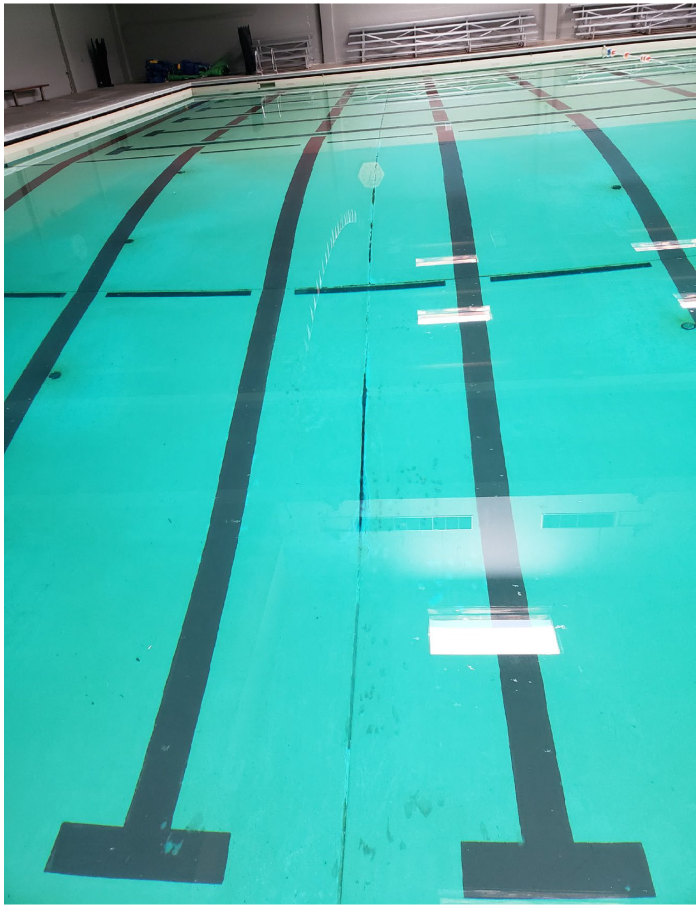
www.andersonpoolworks.com

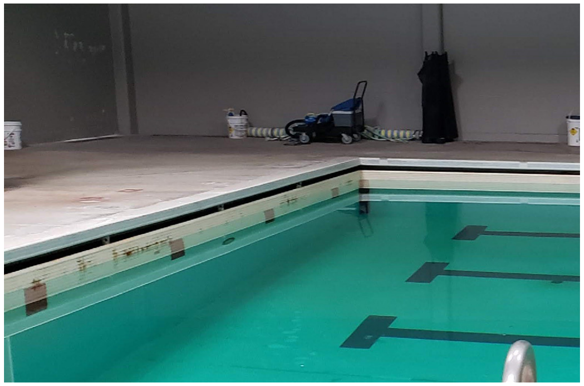
Sandy Aquatic Facility-001.zip
21017K

ATTACHMENT 2

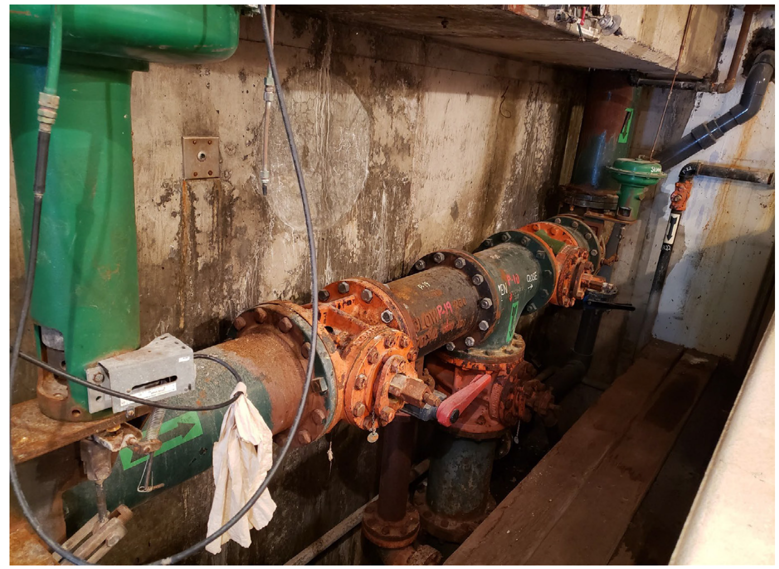
Expansion Joints in Need of Repair



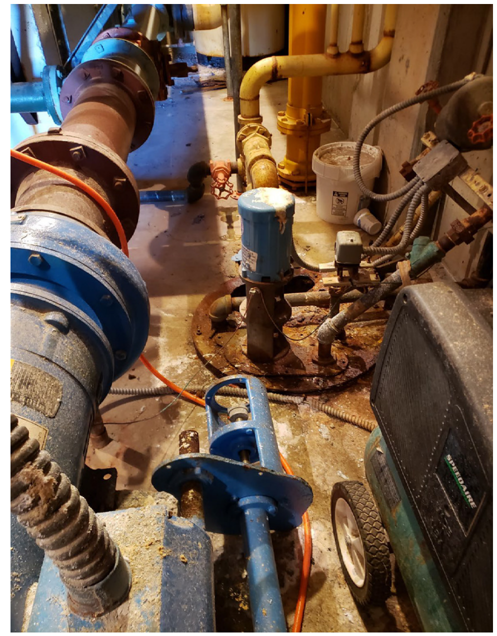
Surge Gutter System Structural Integrity



Iron Pipes and Valves Need Replacement

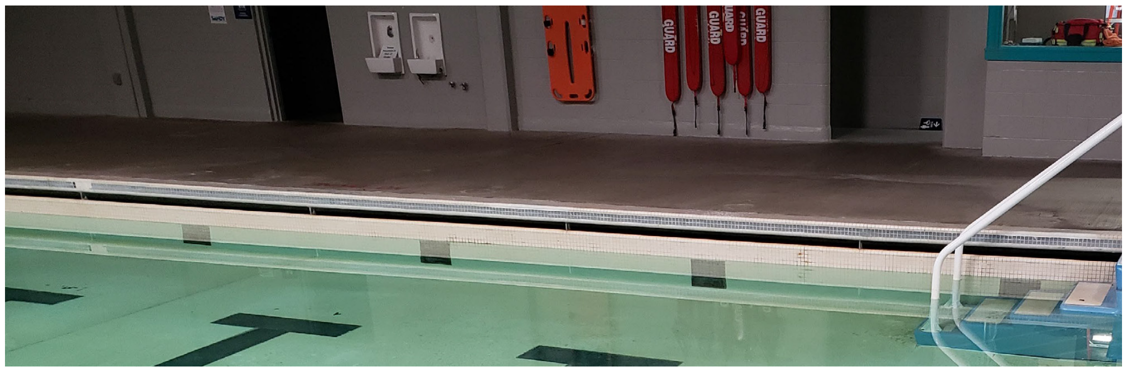


Iron Pipes and Valves Need Replacement



Viewing Port Seal Failure

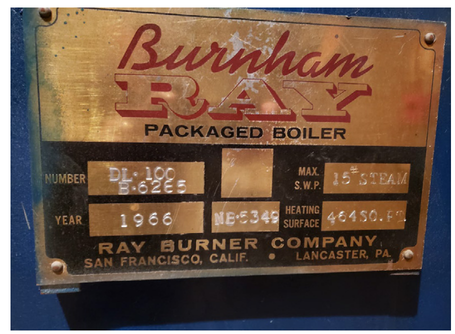
Water Level Concern



Wading Pool Filtration

Chemical Control Unit

Boiler and Filtration System



ATTACHMENT 3

Opsis Architecture
Sandy Aquatic Center Study
09.18.19

SANDY AQUATIC CENTER STUDY
CONCEPTUAL COST MODEL - RENOVATE EXISTING

Renovate existing Aquatic Center so facility will be adequate for the next 15-20 years.

	Area	Cost/SF Range	Cost Range	
Building Costs				
Building Envelope Improvements	16,200 sf	$50 - $75	$810,000 - $1,215,000	
Seismic Upgrades		$35 - $50	$567,000 - $810,000	
Interior finishes		$10 - $15	$162,000 - $243,000	
Electrical and Technology Upgrades		$8 - $10	$129,600 - $162,000	
Lighting Upgrades		$8 - $10	$129,600 - $162,000	
MEP System Replacement		$75 - $100	$1,215,000 - $1,620,000	
Pool Systems (WTI Basic Repairs)			$1,700,000 - $2,200,000	
	16,200 sf	-	$4,713,200 - $6,412,000	
		Average Cost	$5,562,600	
		Design Contingency (30%)	$1,668,780	
		Total Cost of Building Upgrades	**$7,231,380**	$446 sf
Site Improvements				
Entry Plaza Renovation	3,000 sf	$20 - $25	$60,000 - $75,000	
		Average Cost	$67,500	
		Design Contingency (30%)	$20,250	
		Total Cost of Site	**$87,750**	
		Total Average Const Cost	**$7,319,130**	
		Soft Costs (30%)	**$2,195,739**	
		TOTAL PROJECT COST	**$9,514,869**	

Pool Exploratory Task Force Bylaws

Amended: June 21, 2021

Article I: Name

This body shall be known as the Pool Exploratory Task Force (Task Force). It was established by Council motion on April 19, 2021. The body is a 'Task Force,' per the framework established by Resolution 2021-07; as such it is intended to exist on a temporary basis until its purpose is fulfilled.

Article II: Purpose

By January 2022, deliver to the Mayor a strategic path forward for providing and operating a pool and pool programs for Sandy area residents. Potential options include but are not limited to: (1) Repairing and re-opening the Olin Bignall Aquatic Center; (2) Replacing the existing pool with new pool(s); (3) Building a new pool and incorporating parts of the existing pool; or (4) Temporarily re-opening the existing pool and transitioning to new construction. Evaluate and make a recommendation on alternative pool operating models; to include programs, hours, staffing; that maximizes the utilization of the pool, revenue, and minimizes expenses. Identify cost models for the various pool options, including upfront costs, budgets, and revenue streams. Propose a feasible timeline for construction and opening of the pool. Explore the availability of grants or other non-city sources of funding.

Article III: Membership and Terms

The Task Force is comprised of nine (9) seats. Members serve indefinitely until or unless they resign, are removed, or the Task Force is disbanded. The City Council retains sole authority to appoint or remove members. Seat vacancies, applications, and appointment procedures shall be conducted in accordance with the provisions of Resolution 2021-07.

No more than two (2) of the Task Force members may reside outside of the city limits of the City of Sandy. The Task Force may include up to three (3) members of the Sandy City Council ~~and~~. The nine-member Task Force will be assisted by up to two (2) non-voting members from the City of Sandy staff.

To ensure representation of various interests and stakeholders, the Task Force should ideally include members with expertise in some aspect of pool construction, operations, or management; expertise in any aquatic program or sport; grant writing and management; or other relevant interest or experience.

Article IV: Officers

The officers of the Task Force shall be the Chair and Vice Chair. Officers shall be elected at the first meeting of each calendar year. Officer terms shall extend for one year, with no limitation on reelection. The Chair shall preside over meetings and maintain order. The Vice Chair shall preside in the absence of the Chair.

Article V: Code of Conduct

Task Force members shall abide by the Boards and Commissions Code of Conduct and/or any other such requirements established by the City Council.

Article VI: Meetings

The Task Force shall meet not less than six times per year. Meeting dates may be changed or canceled by the Chair, in consultation with the Staff Liaison, with no prior notice to the membership. A majority of the voting membership shall constitute a quorum.

If a member should have two (2) consecutive unexcused absences from regular meetings, he/she may be replaced with a new member appointed by the Sandy City Council.

Article VII: Amendments

Amendments to these bylaws may be made at the City Council's discretion. The Task Force may propose recommended changes to the Council.

opsis

MEETING MINUTES

Meeting Name: PETF Meeting 1
Project Name: Sandy Aquatic Center Study
Project Number: 4843-01
Submitted By: Liz Manser/ Jim Kavelage
Meeting Date: September 15, 2021

	Owner			Design Team		
Attendees:		Kacie Bund	PETF Chair	√	Jim Kalvelage	Opsis Architecture
	√	Meagan Lancaster	PETF Vice Chair	√	Ken Ballard	Ballard*King
	√	Don Hokanson	Councilor	√	Liz Manser	Opsis Architecture
	√	Kathleen Walker	Councilor			
		Carl Exner	Councilor			
		Grant Hayball	PETF Member			
	√	Jan Sharman	PETF Member			
	√	Blake Smith	PETF Member			
	√	Mark Smith	PETF Member			
	√	Jeff Aparti	Assist to City Manager			
Distribution:	Jeff Aparti for Distribution to Owner Group..			Distributed to Design Team		

This represents my understanding of the discussions and directions during the Meeting. Participants should communicate revisions to Opsis Architecture.

OBJECTIVES
This meeting is to review the draft project guiding principles, aquatic program needs, and overall revenue/expense concepts.

Draft Guiding Principles
The draft guiding principles were reviewed and generally fall in alignment with Task Force expectations. These will be used to help determine the final evaluation criteria.

- Two sections (Aquatic Guiding Principles and 'Other Project Considerations') account for both the aquatic needs and an awareness of the larger dryland and community center scope of the project.
- Additional Guiding Principle - Consider potential for future expansion
- *Action: Opsis to refine guiding principles for next PETF meeting. PETF members to consider any additional additions / refinements to draft principles.*

Aquatic Space Program

- Aquatic amenities and features – additional considerations:
  - Waterslide could be indoor/outdoor. Visibility of the slide on southside of building could generate interest/provide advertising. Potential for outdoor slide to save deck space and dry run-out helps maximize pool space.
- Facility Design Attributes – Additional considerations:
  - Universal accessibility
  - Covid 19 / health design strategies
  - Energy efficiency
  - Proper vestibule design – at both the locker room entries and the main exterior entries
  - Proper acoustics in the natatorium

opsis architecture LLP o 503.525.9511 | f 503.525.0440 | 920 NW 17th Ave, Portland, OR 97209 | opsisarch.com

    - Space saving and water efficient filtration system such as a regenerative media filter system should be considered
- Capital Expense vs Revenue of Space Components
    - 6-lane 25-yard pool can still serve as a competition pool. The major benefit of a 50-meter pool is higher swimmer capacity but results in significant operations subsidy. A 50-meter pool doesn't make sense for the Sandy community – nearby facilities w/ 50-meter pools (Mt Hood CC and THPRD).
- Aquatic Options
    - Recreational Pool size:
        - 3,500 SF of water is a 'middle ground' for rec center pools and can accommodate most critical amenities at this size, including zero depth entry with children's play area, program activity area with water aerobics and swim lessons, and small current channel.
        - A 3,500 SF recreation pool vs 2,000 SF offers increased capacity and ability to offer more amenities and zero depth entry.
        - A recreation pool has a warmer water temperature than a competition pool – more conducive for swim lessons, water aerobics classes and therapy.
        - *Action: Opsis to provide images and or locations of similar size pools in PDX area for the PETF members to visit.*
    - Cost recovery potential in Options 2b and 3 is greater with the increased size of the recreational pool.
    - Include a birthday party / event space that can be subdivided.
    - Spectator Seating:
        - Opsis to use 200-seat capacity for space planning purposes. These should be movable bleachers to maximize use of the deck space.
    - Future Planning:
        - All decisions should consider that it is difficult to increase pool size or lane quantity in the future. Pool capacity/size expansion generally requires the addition of new pools.
        - A major renovation would generally have a similar lifespan to new construction, depending on the integrity of the existing structure.
    - Spa/Sauna:
        - Spa should be included in all options. Sauna should *not* be included in the PETF considerations. However, it should be discussed in tandem with the dryland / community center components in future CCS meetings.
    - Depth Considerations:
        - Starting blocks require a 5' depth requirement at each end. This would push some shallow water activities into the recreation pool (aerobics, lessons, etc.).
    - Aquatic Layout Options:
        - Option 1 does not have enough presence along Pleasant Street with lockers facing south and doesn't include a recreation pool.
        - Option 2a includes (2000 SF) recreation pool and 6-lane 25yard pool, The recreation pool was viewed as too small.
        - The PETF recommends developing only option 2b and 3.
        - All options should take into consideration the community center / dryland recreation and fitness components
        - *Action: Opsis to continue the development of Options 2b through 3 for the remainder of the study. Option 1 and 2a are not viable for continued exploration.*

End of Meeting Notes

Attachments: Annotated PETF Meeting-1 Presentation

opsis architecture LLP

POOL EXPLORATORY TASK FORCE - MEETING 1

SANDY OREGON

opsis architecture

BALLARD KING & ASSOCIATES LTD

AGENDA

6:00 - 6:10 **WELCOME/ INTRODUCTIONS** *10 minutes*

6:10 - 6:15 **REVIEW AGENDA/ STUDY TIMELINE** *5 minutes*

6:15 - 6:30 **REVIEW DRAFT PROJECT GUIDING PRINICPLES** *15 minutes*

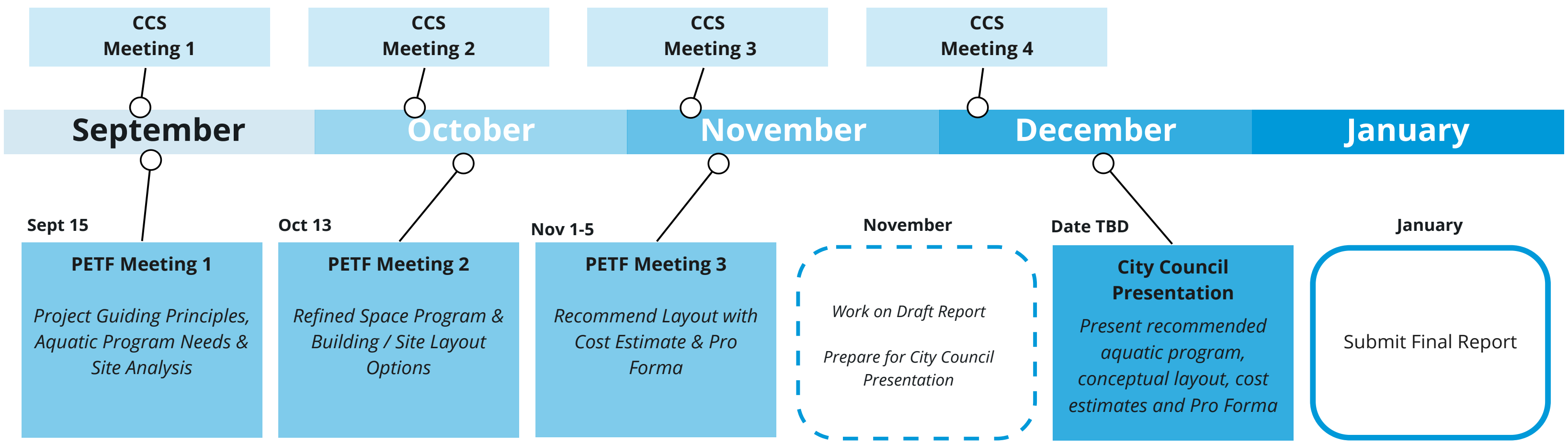
6:30 - 7:30 **REVIEW AQUATIC SPACE PROGRAM** *60 minutes*

- Pool Space Program Options
- Relationship between operational costs and capital costs
- ROM Operation Cost Options

7:30- 7:50 **REVIEW DRAFT AQUATIC LAYOUT OPTIONS** *20 minutes*

7:50- 8:00 **NEXT STEPS** *10 minutes*

STUDY TIMELINE



CCS = Community Campus Subcommittee
PETF = Pool Exploratory Task Force

PROJECT GUIDING PRINCIPLES (DRAFT)

Aquatic Guiding Principles

- Accommodate Lap and Recreation Swim Programs
- Provide Operationally Efficient Layout
- Meet Cost Recovery Goals
- Develop Cost Effective Parking Layout
- Integrate Convenient Service Access to Aquatic Mechanical
- Maximize Value of Investment
- Work Within Budget Constraints
- Compelling Vision for Successful Bond Initiative

splash pad

make sure we dont limit future options

Other Project Considerations

- Integrate Potential Fitness and Community Spaces
- Potential Public Walkway to Park
- Potential Addition of Park Amenity

AQUATIC PROGRAMS & ACTIVITIES

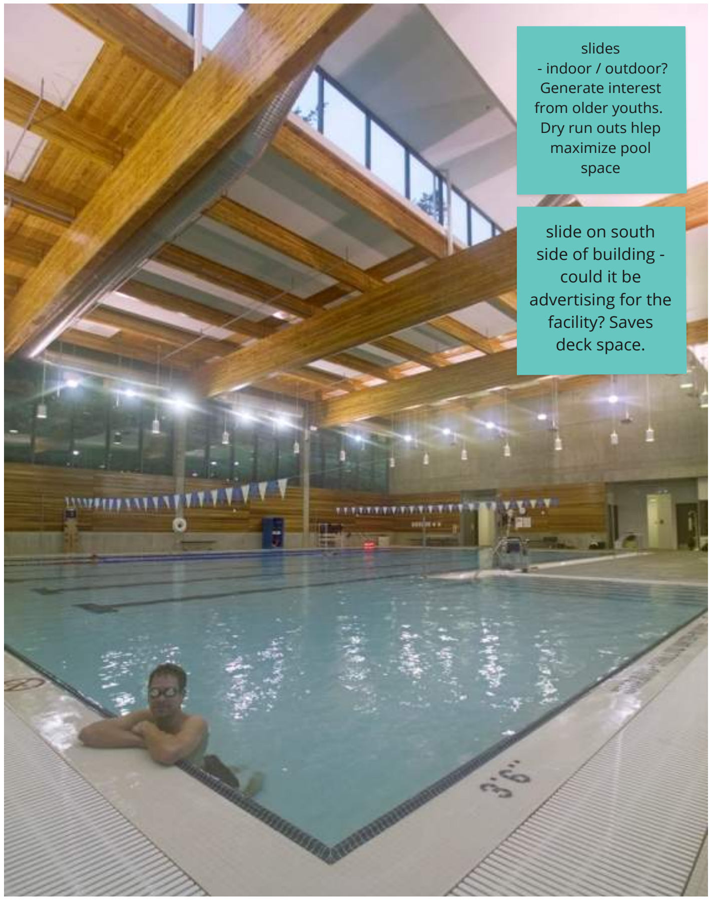
- Swim Lessons
- Children's Play Pool
- Water Aerobics
- Party Rentals
- Physical Therapy
- Lazy River
- Water Basketball
- Water Rock Climbing Wall
- Water Slides
- Swim Teams
- Water Polo
- Scuba diving Kayaking
- Instructor / Lifeguard Training
- Red Cross classes

AQUATIC AMENITIES & FEATURES

Recreation Pool
- Lazy river
- Slides
- Kid's pool
- Hydrotherapy
- Inflatables

Competition Pool
- Swim team practice & meets
- Bleachers
- Water Polo
- Diving boards

General
- Sauna
- Hot Tub
- Party rental rooms
- Restrooms / locker rooms
- Universal changing rooms
- Storage for long-term renters
- Aquatic equipment storage
- Lifeguard / office space
- Lobby w/ seating / pool views
- Snack bar / vendors



slides
- indoor / outdoor? Generate interest from older youths. Dry run outs hlep maximize pool space

slide on south side of building - could it be advertising for the facility? Saves deck space.

FACILITY DESIGN ATTRIBUTES

- Viewing windows into pools
- Indoor / outdoor connections
- Operable windows / natural ventilation
- Natural daylight / views
- Covered entrance / drop-off area

proper acoustics!

need to consider correct vestibule design - locker room to pool and inside to outside

universal accessibility

COVID / health design strategies

energy efficiency is important

REVENUE / SPACE COMPONENT

Potential High Revenues

- Recreation Pool
- Cardio/ Weight
- Gym/Track
- Concessions

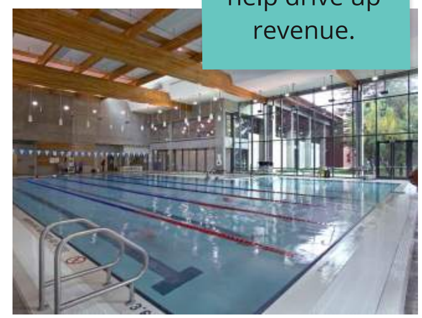
Potential Medium Revenues

- Competitive Pool (25 yard/meter)
- Arts & Crafts Area
- Tot Program Areas
- Game Rooms
- Gymnastics Areas
- Climbing Wall

Potential Low Revenues

- Competitive Pool (50 Meter)
- Seniors Area
- Administrative Support
- Teen Lounge
- Childwatch Area
- Kitchen
- Locker Rooms
- Meeting Rooms

more fitness & 'dry side 'amenities can help drive up revenue.



EXPENSE & REVENUE / SPACE COMPONENT

50 meter pool may not make sense for Sandy community

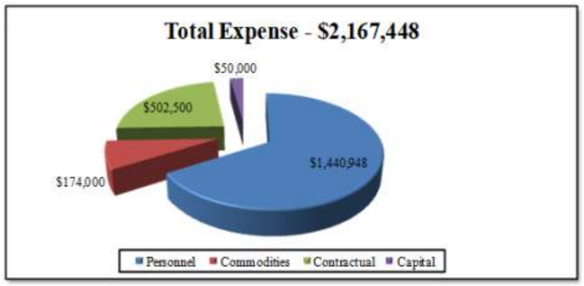
25 meter can serve as competition pool. 50 meter pool has more capacity for swimmers

Component	Expense	Revenue
Conventional Pool (25 yard/meter)	High	Medium
Competitive Pool (50 meter)	High	Low
Leisure Pool	High	High
Gymnasium/Track	Low	High
Meeting/ Multi Purpose Rooms	Medium	Low
Senior Activity Space	Medium	Low
Party Room	Medium	High
Group Exercise Rooms	Medium	High
Weight/ Cardiovasucular Space	Medium	High
Drop In Childcare	High	Low
Game Area	Low	Low
Kitchen	High	Low

acoustics are key design consideration, and will be an important design decision in next phase. Acoustician will be involved

COST RECOVERY PROJECTIONS

Sample Revenue vs Expense Projections



Expense Projections

- Staffing
- Operating Supplies
- Contract Services
- Capital Replacement

Revenue Projections

- Admissions Fees
- Program Fees
- Partnerships

AQUATIC OPTIONS SUMMARY

design consideration: filtration systems should be considered - how labor intensive is it?

cost recovery increases from 1 to 2b (due to recreational pool size)

spectator seating quantity? - confirm existing was sufficient. Used for both competition and general use. Min 200 starting point. moveable bleachers?

hard to increase pool size or lane quantity in the future

spa should be included. No sauna.

major renovation would have similar lifespan/ longevity to new building

Difference between 2k and 3.5k pool size - increased capacity and less limitations on amenities.

3,500 sf is 'middle ground' for rec pool sizes. Can build in most critical amenities at this size (ie zero depth)

Option 1

Existing Natatorium with Existing Pools
6 lane 25-yard x 25-meter pool (4800 sf of water) w/ existing wading pool (560 sf of water)

Option 2a

Existing Natatorium with Modified Lap Pool - No Addition
6 lane 25-yard pool (3,150 sf of water) w/ recreation pool (2,000 sf of water) and spa (230 sf of water) contained within existing natatorium enclosure

Option 2b

Existing Natatorium with Modified Lap Pool - With Addition
6 lane 25-yard pool (3,150 sf of water) w/ recreation pool (3,500 sf of water) and spa (230 sf of water) that includes expanded natatorium.

Option 3

New Natatorium (location TBD)
6 lane 25-yard pool (3,150 sf of water) w/ recreation pool (3,500 sf of water) and spa (230 sf of water)

All options include: new entry, locker rooms, administrative offices, and potential to add fitness and community spaces

Option: Only 1 body of water (rec pool) with 4 lap lanes. Potentially eliminates large user group (competitive users and serious lap swimmers who would prefer cooler water temp)

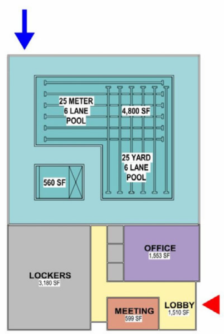
3600 SF Firstenburg pool

Design team to show pictures of similar size pools

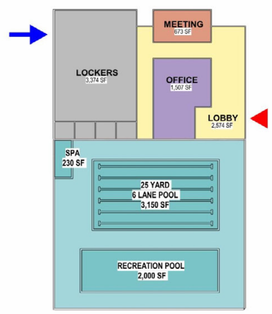
AQUATIC LAYOUT OPTIONS

design team should focus on 2b and 3

OPTION 1



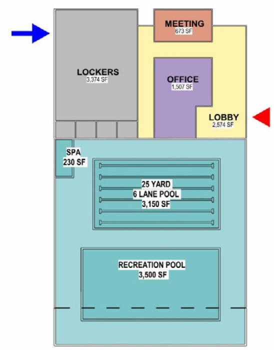
OPTION 2A



rec pool should face pleasant street

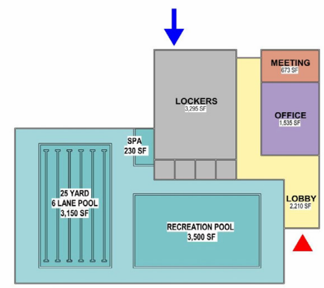
consideration - remember that it will be tied to community center. lockers/ lobby

OPTION 2B



how many birthday rooms?

OPTION 3



Does sauna/steam room drive revenue? Used by patrons utilizing dry side amenities. For this committee - assume this is part of the community center amenities.

NEXT STEPS

Next Pool Exploratory Task Force Meeting:
October 13

show images of comparable pools

opsis

MEETING MINUTES

Meeting Name: PETF Meeting 2

Project Name: Sandy Aquatic Center Study

Project Number: 4843-01

Submitted By: Liz Manser/ Jim Kavelage

Meeting Date: October 13, 2021

Attendees:	**Owner**			**Design Team**		
		Kacie Bund	PETF Chair	√	Jim Kalvelage	Opsis Architecture
	√	Meagan Lancaster	PETF Vice Chair	√	Ken Ballard	Ballard*King
	√	Don Hokanson	Councilor	√	Liz Manser	Opsis Architecture
	√	Kathleen Walker	Councilor			
	√	Carl Exner	Councilor			
		Grant Hayball	PETF Member			
	√	Jan Sharman	PETF Member			
	√	Blake Smith	PETF Member			
		Mark Smith	PETF Member			
	√	Jeff Aparti	Assist to City Manager			
Distribution:	Jeff Aparti for Distribution to Owner Group..			Distributed to Design Team		

This represents my understanding of the discussions and directions during the Meeting. Participants should communicate revisions to Opsis Architecture.

OBJECTIVES
This meeting is to review the feedback from TF meeting1, discuss the detailed aquatic program, and review refined space layouts.

Study Timeline
The updated timeline was reviewed, with a request from Opsis to push the final PETF meeting into December to provide more developed cost and operations information and allow the PETF to make a more informed recommendation for the preferred option. This does not extend the study timeline.

Feedback from Last PETF Meeting

- No updates were made to the draft guiding principles. These will become the basis for the preferred option evaluation matrix
- Updated facility design attributes were shared.
- Comparative pool sizes were discussed, driving a conversation about desirable design to consider
    - ADA access requirements to competition pool (ramps/lift).
    - Desire to create spaces to congregate (ie Firstenburg's walls).
    - Opportunities to provide views down into the pool from an upper level – allowing visitors to passively experience the space.
    - Provide ample deck seating for parents and non-swimmers.
    - In all the 3500 SF pool precedents, the visitors seem evenly distributed across the pool, and all seem full of people.
    - Approximately 30% of the rec pool should be allocated to children's activities – the zero depth entry takes a lot of space.

- Location of Spa – it is well suited for adjacency to the rec pool, but potentially not the zero entry side.
- Future pool expansion based on community growth (ie – future pool tanks, expanded pool tanks, etc) should **not** be considered when designing the aquatic center.

Aquatic Space Program
A preliminary aquatic space program with designated SF was reviewed. This is a portion of the more comprehensive campus wide space program that is being developed

- Several areas may grow slightly during design – the break room and warm water deck size.
- A 600 SF meeting room could be subdivided with a moveable partition to provide several smaller rooms
- The sauna is **not** included in the current program. It could be added back in later in design as it is a smaller program element. Typically, saunas are accessed from the deck for greater supervision and visibility.
- The group discussed the pros and cons of a deep-deep vs shallow-deep competition pool. Deep-Deep providing a better environment for water polo, but more is restrictive for lessons and aerobics classes.
- The group discussed the pros and cons of a 6 vs 8 lane competition pool. Operational expenses increase with additional lanes (ie 50-100k a year). More lanes would allow future growth and more robust programming opportunities (larger swim meets, etc).
- *Action Item: Design team to move forward with a 7' deep, deep-deep competition pool.*
- *Action Item: Design team to move forward with a base design of 6 lanes, with additional pricing/capital cost information for 8 lanes. PETF will discuss at next TF meeting.*

Review of Updated Aquatic Layout Options
At the previous PETF Meeting, 4 options were presented. It was decided to continue to refine the design of option 2b (existing natatorium with an addition) and 3a (a new natatorium).

- Both Option 2B and 3A allow for an 8 lane pool if desired.
- Option 2B Updates
  - Design team to explore architectural solutions to create safe access to the recreation pool, without relocating the pool closer to the locker rooms.
  - Examine potential ways to increase deck area by pulling slide partially out of the building
  - Look at ways to make the slide visible from the street.
  - The group discussed other options for expanding besides just to the south and north – however site constraints such as parking and site visibility make a north/south addition more viable.

Next Steps

- The group discussed the goals of the next meeting:
  - Review Option 2b (Natatorium) & 3a (Bunker Building) on the site
  - Review Capital Cost Information
  - Review Operational Costs
  - Review Draft Concept Evaluation Matrix
  - Determine Recommended Option
- Next meeting date was set for December 1st.

End of Meeting Notes
Attachments: Annotated PETF Meeting-2 Presentation

opsis

MEETING MINUTES

Meeting Name: PETF Meeting 3

Project Name: Sandy Aquatic Center Study

Project Number: 4843-01

Submitted By: Liz Manser/ Jim Kalvelage

Meeting Date: December 1, 2021

Attendees:	**Owner**			**Design Team**		
	√	Kacie Bund	PETF Chair	√	Jim Kalvelage	Opsis Architecture
	√	Meagan Lancaster	PETF Vice Chair	√	Ken Ballard	Ballard*King
	√	Don Hokanson	Councilor	√	Liz Manser	Opsis Architecture
	√	Kathleen Walker	Councilor			
	√	Carl Exner	Councilor			
		Grant Hayball	PETF Member			
	√	Jan Sharman	PETF Member			
	√	Blake Smith	PETF Member			
		Mark Smith	PETF Member			
	√	Jeff Aparti	Assist to City Manager			
Distribution:	Jeff Aparti for Distribution to Owner Group..			Distributed to Design Team		

This represents my understanding of the discussions and directions during the Meeting. Participants should communicate revisions to Opsis Architecture.

OBJECTIVES

This meeting is to review the feedback from TF meeting 2, review both options in the context of the larger site, review capital and operational cost information, discuss the evaluation matrix and determine the preferred option to recommend to the city council.

Preferred Aquatic Options

- Option 2B and 3A layouts we reviewed with the group. Supervision issues tied to the location of the recreational pool in 2B were discussed – and could be addressed to some extent during the next phase of design (including moving the spa to allow a wider circulation path from the locker rooms to the rec pool).

Overall Campus Program.

- A preliminary program for the recreational/community center aspects of the project was shared. This will be developed in more detail with other focus groups in the next phase of this project and will take into account the programmatic aquatic needs that were determined during this phase.

Option 2B

- Option 2B leverages the natatorium portion of the existing aquatics building with addition(s).
- The remainder of the community center programming would happen in the 'bunker building'.
- The separate buildings create an operational challenge, and would require additional staff or a large, multi level lobby to connect the two buildings. These operational cost implications are not reflected in the capital cost estimate.
- Developing the scheme shown in option 2B would require dealing with the unknown conditions associated with (2) existing buildings, as opposed to only (1) existing building in option 3A.

Option 3A

- The parking count and layout will need to be explored in more detail during the next phase to that we have both adequate parking and safe pedestrian access through the site.
- Need to ensure that there is adequate lounge/ deck seating around the recreation pool
- Vending/ Concessions area will need to be located somewhere in this scheme. If it is located as part of the front desk area, it helps minimize additional staffing requirements.
- Pool mechanical is currently located below the natatorium. The design team will work with WTI to determine if this is the best location during the next phase.
- Mechanical systems will be explored in more detail in the next phase.
- An easement exists near the elementary school which could help provide better service access to the site.

Capital Cost Considerations

- The aquatics portion of the overall campus construction cost were significantly lower for option 3A
- The construction cost per square foot for both 2B and 3A are comparable to similar, local aquatic centers escalated to a 2023 construction start date.
- The ROM costs presented will be refined during the next phase of the study, and the design team will work to reduce cost/SF as additional investigation of the existing buildings has been completed, and site development scope and building systems design are better defined.

Operational Cost Considerations

- Aquatics would account for a large amount of the overall campus subsidy (approximately $500,000 out of $700,000 total)
- The operational assumptions shared were based off of a 6 lane pool. An 8 lane pool would add approximately an additional $100,000 to the aquatics subsidy required.
- Generally, aquatics visitors would account for approximately 1/3 of the total visitors to the campus.

Evaluation Matrix

- 3A has a more efficient layout with lower operational and capital costs
- The current aquatics program provides a balance between recreation and competition elements.
- An 8 lane pool could have additional staff training/athlete development benefits
- Overall project costs may change with additional input from community center focus groups during the next phase of the project.
- 3A is the preferred option of the PETF.

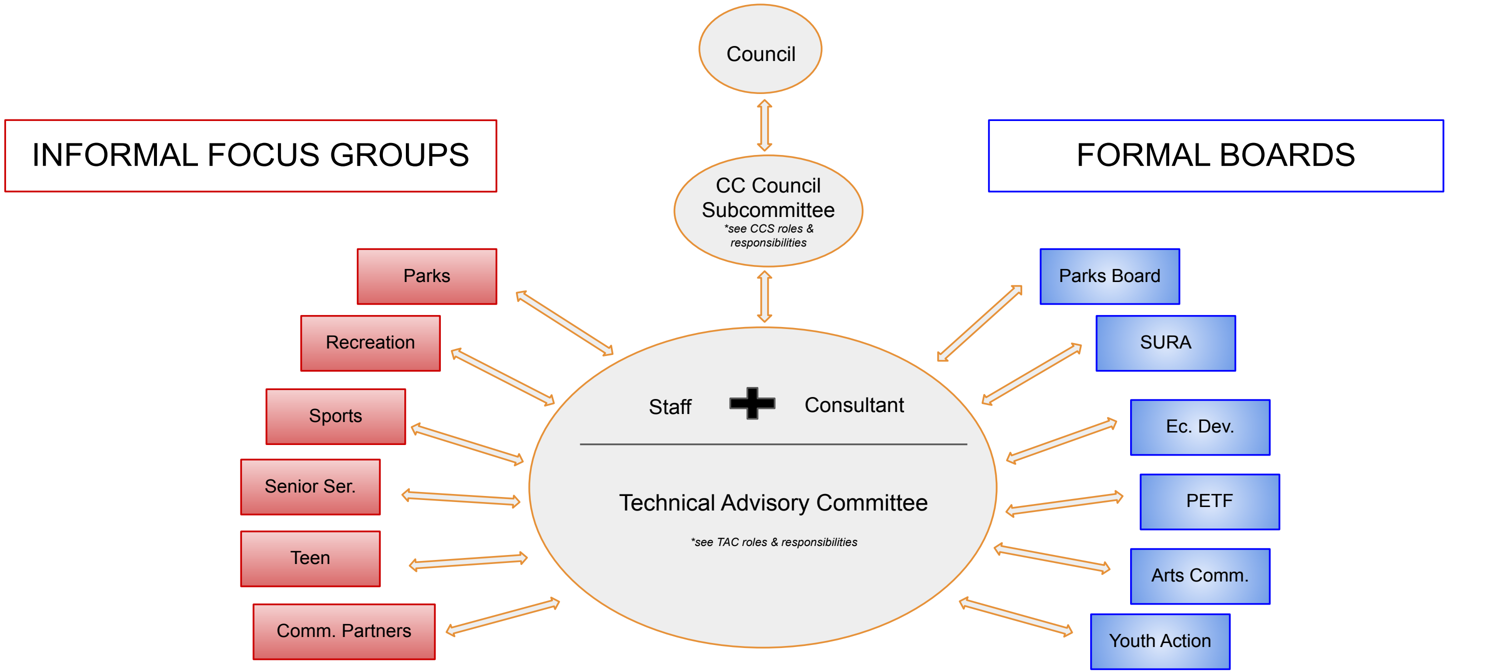
Next Steps

- Opsis to draft final report and submit to TF chairs for input and review.
- A revised draft report should be shared with the TF for input and review.
- Report should express a strong recommendation for an 8 lane competition pool and include capital / operational comparison between a 6 and 8 lane pool.

End of Meeting Notes
Attachments: Annotated PETF Meeting-3 Presentation

opsis architecture LLP

Community Campus Context Process Chart



Final Outcome / Deliverables

(1) A conceptual design for a community and recreation center *(bond ready rendering/schematics)*.

(2) Design development, construction drawings, bid and build documents for park improvements and infrastructure *(shovel ready park project)*.

General Obligation Bond Examples

									Annual Tax Increase Examples per Household Assessed Values				
Bond Issue	Interest Rate	Term	Debt Service Needed	Collection rate	Amount Needed		Total Assessed Value (est.)	Tax Rate per 1000 AV	$150,000	$200,000	$250,000	$300,000	$350,000
1,000,000	4%	30	($57,830)	95%	($60,721.6)		1,003,373,485	$0.06	$9.08	$12.10	$15.13	$18.16	$21.18
2,000,000	4%	30	($115,660)	95%	($121,443.2)		1,003,373,485	$0.12	$18.16	$24.21	$30.26	$36.31	$42.36
5,000,000	4%	30	($289,150)	95%	($303,608.0)		1,003,373,485	$0.30	$45.39	$60.52	$75.65	$90.78	$105.91
10,000,000	4%	30	($578,301)	95%	($607,216.0)		1,003,373,485	$0.61	$90.78	$121.03	$151.29	$181.55	$211.81
15,000,000	4%	30	($867,451)	95%	($910,824.1)		1,003,373,485	$0.91	$136.16	$181.55	$226.94	$272.33	$317.72
17,000,000	4%	30	($983,112)	95%	($1,032,267.3)		1,003,373,485	$1.03	$154.32	$205.76	$257.20	$308.64	$360.08
22,000,000	4%	30	($1,272,262)	95%	($1,335,875.3)		1,003,373,485	$1.33	$199.71	$266.28	$332.85	$399.42	$465.98
25,000,000	4%	30	($1,445,752)	95%	($1,518,040.1)		1,003,373,485	$1.51	$226.94	$302.59	$378.23	$453.88	$529.53
30,000,000	4%	30	($1,734,903)	95%	($1,821,648.1)		1,003,373,485	$1.82	$272.33	$363.10	$453.88	$544.66	$635.43
35,000,000	4%	30	($2,024,053)	95%	($2,125,256.1)		1,003,373,485	$2.12	$317.72	$423.62	$529.53	$635.43	$741.34
37,000,000	4%	30	($2,139,714)	95%	($2,246,699.4)		1,003,373,485	$2.24	$335.87	$447.83	$559.79	$671.74	$783.70
40,000,000	4%	30	($2,313,204)	95%	($2,428,864.2)		1,003,373,485	$2.42	$363.10	$484.14	$605.17	$726.21	$847.24
45,000,000	4%	30	($2,602,354)	95%	($2,732,472.2)		1,003,373,485	$2.72	$408.49	$544.66	$680.82	$816.99	$953.15
Per mo. $30M							Per month for $30M		**$22.69**	**$30.26**	**$37.82**	**$45.39**	**$52.95**
Per mo. $37M							Per month for $37M		**$26.48**	**$35.30**	**$44.13**	**$52.95**	**$61.78**
Per mo. $40M							Per month for $40M		**$30.26**	**$40.34**	**$50.43**	**$60.52**	**$70.60**

Previous AV	$ 960,166,014.00
Growth rate	4.5%
New Growth	43,207,470.63
Est. AV	**$ 1,003,373,484.63**

Staff Report

Meeting Date:	March 5, 2022
From	Jordan Wheeler, City Manager
SUBJECT:	Highway 26 Bypass Next Steps

BACKGROUND / CONTEXT:
On December 13th, the Council received the results of an initial study on the Highway 26 bypass concept (attached to this staff report for reference).

The study included, but was not limited to, an analysis of the existing and future transportation system performance, potential benefits and negative impacts to local businesses, safety, hard costs associated with different aspects of the Bypass system, traffic forecasts, and a policy and regulatory considerations memo. The December 13th report also mentioned the ODOT policy of requiring 'alternative mobility standards' prior to adding additional vehicular lanes or alternative routes.

As is evident in the study, the estimate to construct a bypass is approximately $365 million to $390 million in 2021 dollars and $980 million to $1 billion in 2040 dollars. There are also costs associated with the jurisdictional transfer of the existing Highway 26 section (5 miles) that currently runs through Sandy. The evaluation also included a conceptual design and alignment of the bypass and how it could interact and connect with the existing and planned street and highway network.

KEY CONSIDERATIONS / ANALYSIS:
If the Council wishes to continue to pursue the bypass, next steps in this process could include:

- Including the project in City's Transportation System Plan (TSP)
- Drafting letters and scheduling meetings with state and local agencies (i.e., DLCD, ODOT, Clackamas County, etc.) to gain support for the bypass as a regional priority and understand regulatory requirements
- Getting the project added in the County's TSP
- Retaining consultant assistance to navigate the regulatory and funding process

RECOMMENDATION:
Provide direction to staff on desired next steps for this project.

LIST OF ATTACHMENTS/EXHIBITS:
- Bypass Feasibility Report

2

SANDY BYPASS REPORT SUMMARY

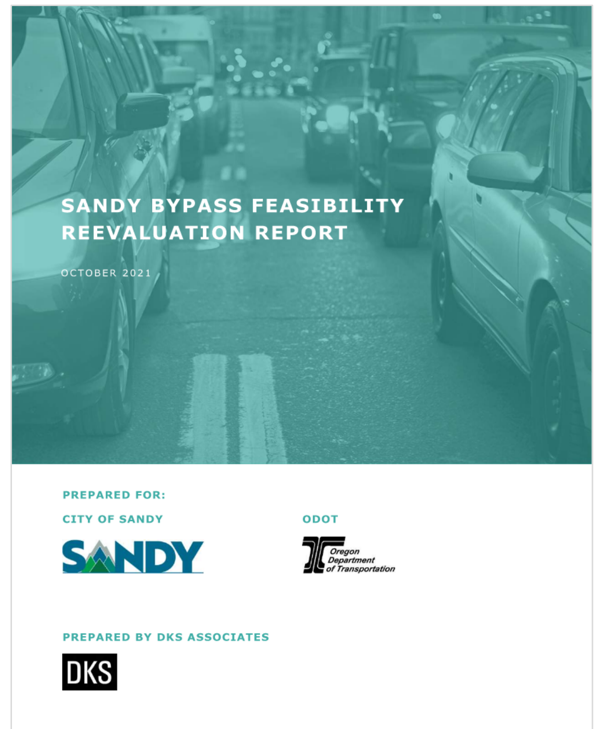
BYPASS FEASIBILITY REEVALUATION STUDY

Objective

Feasibility Reevaluation Study provided a refresh of the 2011 Sandy TSP analysis, expanded measures for high-level benefit cost analysis

Sandy TSP Update will consider findings from the feasibility study with other motor vehicle projects and priorities.

Bypass project is a potential long-term and unfunded TSP solution to address mobility and local growth goals beyond 2040.



BYPASS EVALUATION

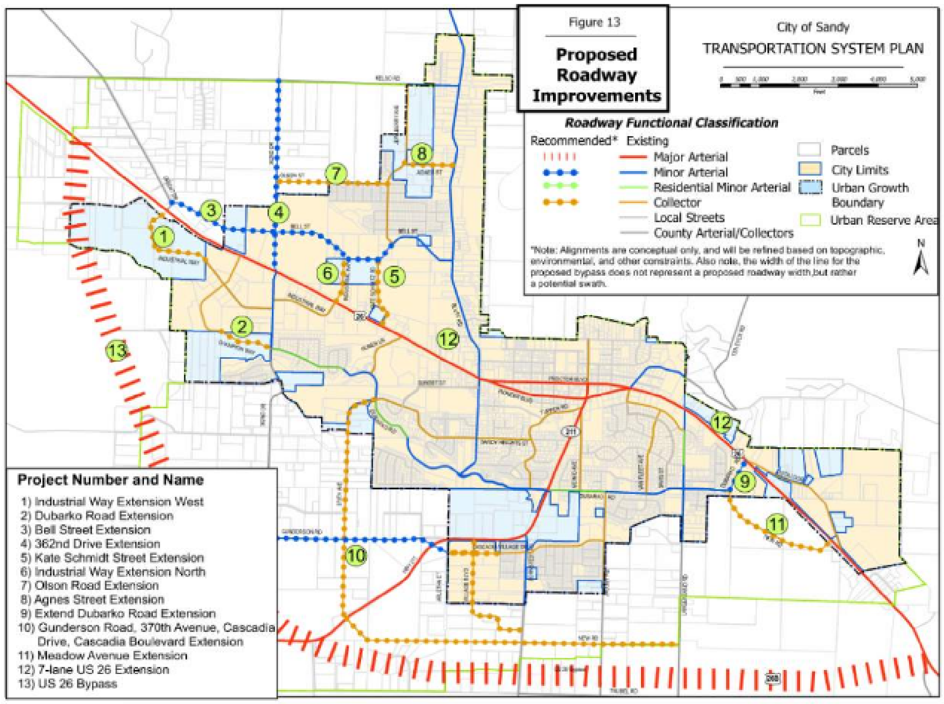
Conceptual Alignment

- Bypass would be located south of Sandy UGB and 5.8 miles long
- West end would connect to US 26 west of Orient Drive with new interchange.
- East end would connect to US 26 at Firwood with new interchange.
- Central interchange at OR 211.
- Grade separated overcrossing at 362nd Dr.
- 120-foot-wide right-of-way with 4 vehicle lanes, raised median, shoulder, lighting, trees and utility easement.

BYPASS EVALUATION

Transportation Analysis

- 2040 No Build: existing + fully funded projects
- 2040 Alternative #1: Local connectivity and intersection capacity projects
- 2040 Alternative #3: Alt #1 + Bypass



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BENEFIT COST MEASURES

Measure	Cost/Impact	Benefit
Project Planning and Construction Cost	Bypass would cost $980 million to $1 billion (in 2040 dollars) for construction, right-of-way acquisition, easements, design and construction management	
2040 Future Traffic Demand		Bypass is estimated to serve 1,500 vehicles during future peak hour. Existing US 26 is estimated to serve 2,300 vehicles during future peak hour.
2040 Future Travel Time		Adding the bypass to other Alternative #1 projects would save an additional 4 minutes and 30 seconds travelling eastbound and no savings travelling westbound on existing US 26. Under Alternative #3, the bypass would have shorter travel times compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.
Travel Time Value		Save $6 million per year, $75 million over 20 years

Measure	Cost/Impact	Benefit
Safety		Overall reduction in crashes on existing US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.
Jurisdictional Transfer to City	City would be responsible for US 26 maintenance after construction of the bypass, estimated to cost $5 to 8 million over 20 years. Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements could increase congestion and travel times through Sandy.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $55 to $105 million
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.	

DKS

FURTHER CONSIDERATIONS

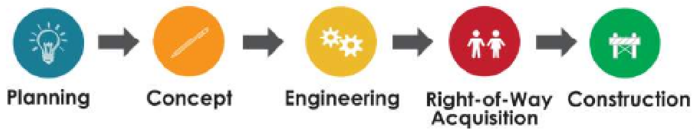
Regulations

- Demonstrate compliance with several State policies and regulations required if bypass is pursued and further developed. The bypass would require the Oregon Transportation Commission to adopt a facility plan and an Oregon Highway Plan amendment.
- OHP Policy 1G and 1H: existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. A bypass is categorized under the lowest level of priority. Planning process must show other improvements cannot adequately support safety, growth management and other livability and economic goals.
- Sandy and Clackamas County need to work together on necessary amendments to local plans to support bypass project.
- Bypass would likely impact land designated for forest use, County would need to support adoption of Goal 5 resource exception findings.

FURTHER CONSIDERATIONS

Schedule and Funding

- Due to project magnitude, construction in 2040 is the earliest reasonable schedule



- Major infrastructure projects use a wide variety of revenue and funding, multiple sources for each phase, compete with other state priorities.

DKS

SANDY BYPASS FEASIBILITY REEVALUATION REPORT

OCTOBER 2021

PREPARED FOR:

CITY OF SANDY

ODOT

Oregon Department of Transportation

PREPARED BY DKS ASSOCIATES

DKS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THIS REPORT PRESENTS THE FEASIBILITY REEVALUATION CONDUCTED FOR THE US 26 BYPASS PROJECT IDENTIFIED IN THE 2011 SANDY TRANSPORTATION SYSTEM PLAN (TSP).[1] THE REPORT PROVIDES AN EXECUTIVE SUMMARY FOR EACH REEVALUATION PHASE: EXISTING AND FUTURE TRANSPORTATION SYSTEM PERFORMANCE, BENEFIT COST ANALYSIS, AND POLICY AND REGULATORY CONSIDERATIONS. THE DETAILED ANALYSIS FOR EACH OF THESE PHASES ARE DOCUMENTED IN THE APPENDIX MATERIALS. THE SANDY TSP IS CURRENTLY BEING UPDATED. THE TSP UPDATE PLANNING PROCESS WILL INCORPORATE THE FINDINGS AND RECOMMENDATIONS FROM THIS REEVALUATION OF THE BYPASS WHEN DEVELOPING THE MOTOR VEHICLE PROJECT LIST AND PRIORITIES.

EXISTING AND FUTURE TRANSPORTATION SYSTEM PERFORMANCE

EXISTING PERFORMANCE

The existing transportation system was evaluated along US 26 through Sandy, focused on the segment between the intersections of SE Orient Drive and Firwood Drive at Shorty's Corner. The existing transportation system performance analysis documented the current vehicle travel conditions through the City and provided a framework to compare and evaluate the effectiveness of a potential alternative route to US 26.

The existing conditions are based on October 2020 count data that was adjusted to represent the level of traffic that is typically encountered during the peak travel month. The existing motor vehicle operations analysis revealed that two intersections do not meet mobility targets during the peak hour; US 26/Orient Drive and US 26/362nd Drive. At both intersections, the eastbound though-traffic volume on US 26 is at or near the available capacity, a condition that has a significant impact on the overall operation of each intersection.

A travel pattern analysis was conducted using StreetLight data, a big-data provider that aggregates location-based information that can be analyzed to provide insight into travel behavior. The existing travel patterns in Sandy and on US 26 suggested around 30 to 40 percent of vehicles on US 26 would likely divert to a new bypass facility. The StreetLight data was also used to approximate existing travel times on US 26 through Sandy to determine potential benefits associated with a bypass project.

[1] Sandy Transportation System Plan, DKS Associates, adopted December 2011.

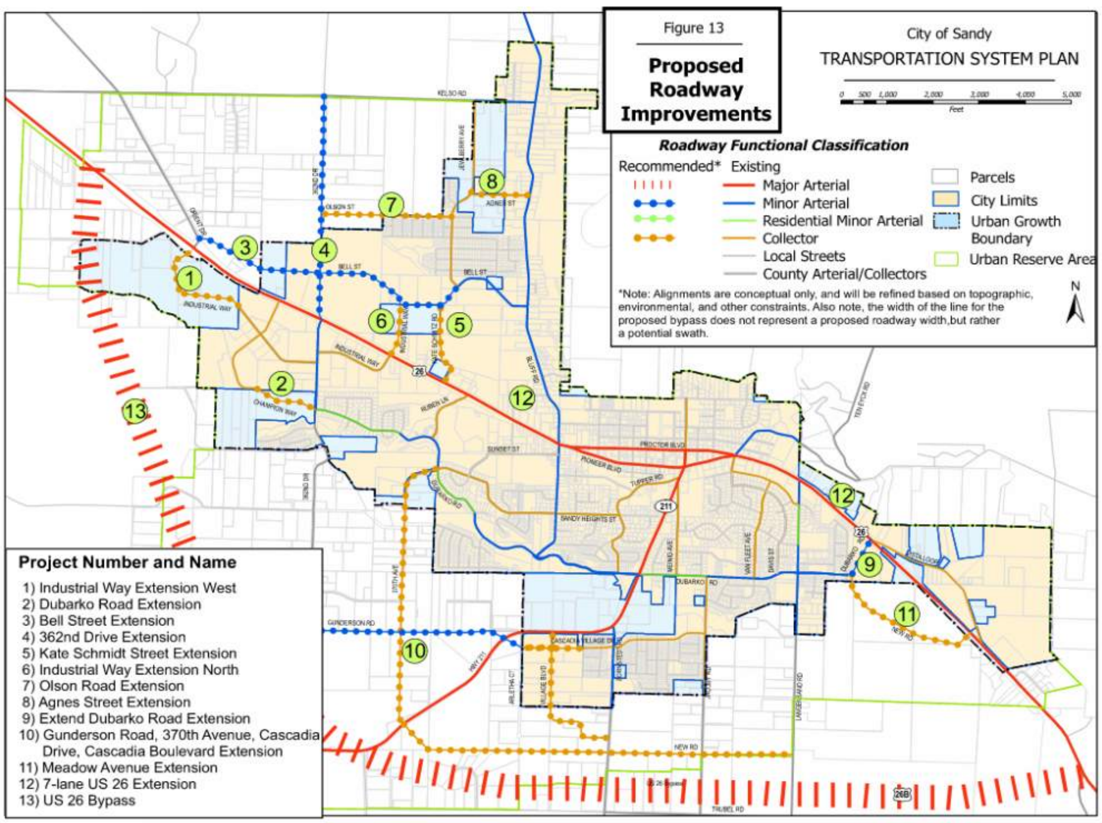
FUTURE PERFORMANCE

Future improvement alternatives were previously developed as part of the 2011 Sandy Transportation System Plan (TSP)[2]. Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described below. TSP Alternative #2 was not included in this study. The Future Transportation System Performance memo in the Appendix provides details on the alternatives and the operations analysis.

2040 No Build Alternative represented the existing system plus several roadway projects that are fully funded and/or currently in the design phase.

2040 Alternative #1 included several street connectivity projects and intersection capacity projects as shown in Figure 1, excluding the conceptual bypass alignment.

FIGURE 1: SANDY TSP MOTOR VEHICLE SYSTEM PLAN



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[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- With the addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern portion of Sandy.
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Compared to the 2040 No Build Alternative, adding Alternative #1 improvements would reduce travel times on US 26 approximately 3 minutes 30 seconds travelling eastbound and 4 minutes travelling westbound
- Adding the Alternative #3 bypass facility to Alternative #1 improvements would reduce travel times an additional 4 minutes and 30 seconds travelling eastbound and no change travelling westbound on existing US 26.
- Under Alternative #3, the bypass facility would have shorter travel times through the study area compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.

BENEFIT COST ANALYSIS

A benefit cost analysis was conducted to provide a planning-level assessment of the potential benefits and costs associated with the bypass facility using performance measures related to the construction cost, value of travel time, safety, local businesses, and regulatory requirements. The following sections summarize the findings.

PREFERRED CONCEPTUAL ALIGNMENT

A conceptual alignment and planning-level cost estimate was developed for the bypass. The US 26 bypass conceptual alignment developed for the 2011 Sandy TSP was refined based on updated future traffic operations and more detailed design considerations for topography, environmental constraints, and freeway design standards.

The conceptual alignment for the bypass is shown in Figure 2 and Appendix Section 1. The bypass features and design parameters are summarized below.

- The facility would be located south of the Sandy Urban Growth Boundary and approximately 5.8 miles long.
- The west end of the bypass would connect to US 26 approximately 2,400 feet west of Orient Drive. The new intersection on US 26 would be an interchange configuration.
- The east end of the bypass would connect to US 26 at Firwood Road (Shorty's Corner). The existing intersection would be converted to an interchange configuration.
- The new bypass intersection with OR 211 would be an interchange configuration.
- The bypass facility would provide a grade separated overcrossing at 362nd Drive.
- The facility would provide a 120-foot-wide right-of-way to accommodate four travel lanes (two each direction), raised median, shoulder area, lighting, trees and public utility easement.

FIGURE 2: US 26 BYPASS CONCEPTUAL ALIGNMENT

The primary purpose of the bypass is to serve regional traffic demand that currently travels on US 26 through Sandy. The interchanges at each end of the bypass and OR 211 would provide the primary access to the bypass. The rest of the facility would be limited to right-in/right-out access at key intersections to reduce conflicts and provide reliable free-flow traffic operations. The remaining streets that intersect the bypass conceptual alignment would be closed and an alternative street network would be provided.

A cost estimate was prepared based on a 10% design concept for the bypass shown in Figure 1. The total cost estimate accounts for construction, utility and slope easements, right-of-way acquisition and professional services to administer design and construction management. The cost estimate is approximately $365 to $390 million in current year 2021 dollars. The detailed cost estimate is shown in Appendix Section 2. The cost estimate when adjusted for inflation to represent year 2040 is approximately $980 million to $1 billion.

VALUE OF TIME IN TRAVEL

Comparing No Build and Alternative #3, the hourly time savings benefit during the 2040 peak hour is approximately $3,700. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $1 million per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $6,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $74.8 million.

Based on the travel time savings between Alternative #1 and Alternative #3 shown in Table 2, the hourly benefit during the 2040 peak hour is approximately $1,900. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $500,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $3,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $37.4 million.

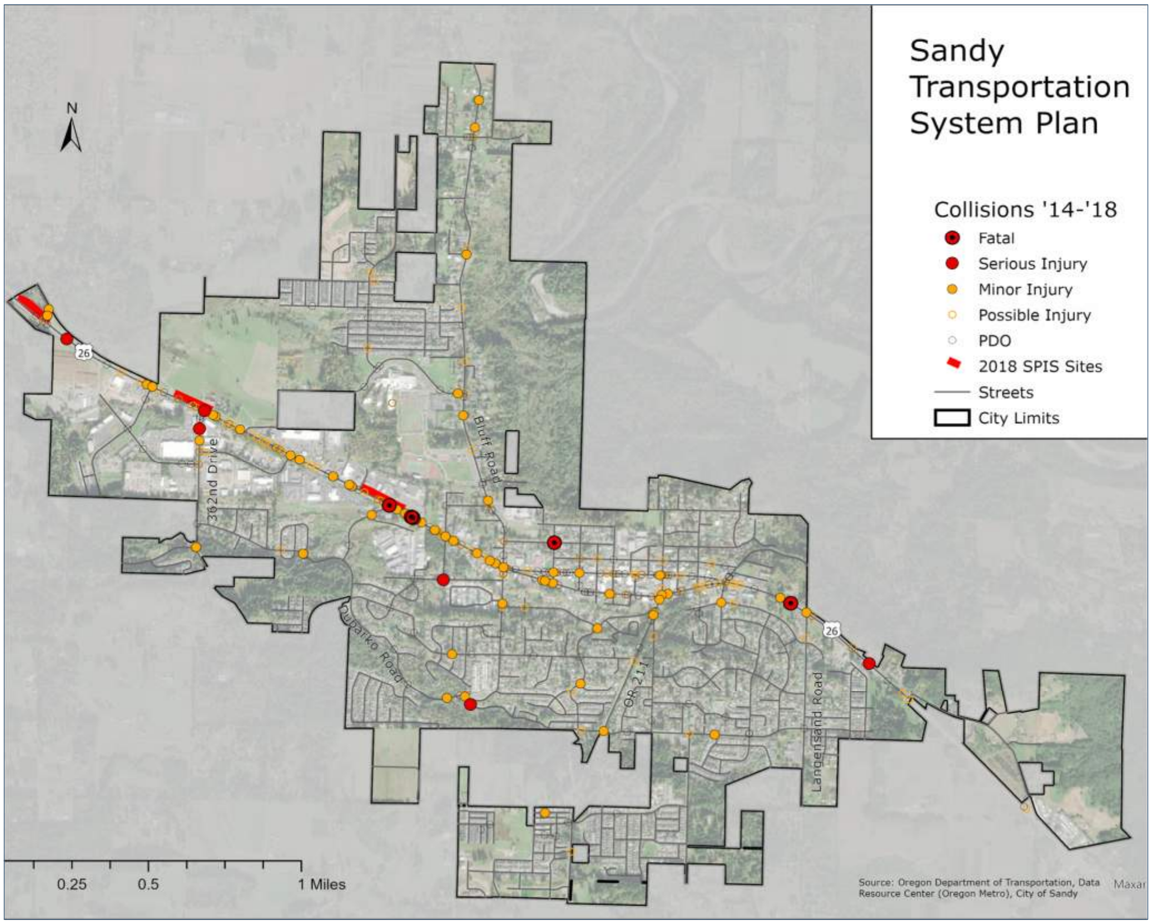
SAFETY ANALYSIS

A safety analysis was conducted for US 26 between the bypass end points. The most recent five years of available collision data, 2014 to 2018, was reviewed to document the severity of collisions and calculate the crash rate. The collision data compiled for the Sandy TSP Update is shown in Figure 3 and includes the focused US 26 safety data used for this analysis.

In total, the US 26 corridor experienced 338 crashes over the five-year study period, including four fatal crashes and five serious injury crashes. All four fatal crashes involved a driver under the influence of alcohol or drugs. The study corridor experienced a total of 213 crashes that were non-intersection related. Key findings include:

- The segment along US 26 between Ruben Lane and Bluff Road reported the highest number of crashes and the highest crash rate compared to the other segments.
- The top three collision types reported for segments were rear-end (56%), turning (16%), and sideswipe (13%).
- The top three contributing circumstances were reported failure to avoid (32%), failure to yield (16%), and following too close (14%).

FIGURE 3: SANDY SAFETY ASSESSMENT – 2014 TO 2018



It is estimated the construction of the bypass facility would moderately improve safety on US 26 between Orient Drive and Firwood Road. Based on the literature review, it is likely that the number of crashes on the existing US 26 through Sandy would be reduced if proper safety measures are implemented for the bypass construction. In particular, appropriate wayfinding signage and speed limit setting for both the main road and the new bypass would need to be planned thoughtfully for both local residents and regional travelers.

Overall, construction of the bypass facility is expected to reduce the level of traffic traveling on the existing US 26 and avoid vulnerable travelers (i.e. pedestrians and bicyclists) by rerouting traffic away from the commercial and downtown areas. Regional traffic travelling on the bypass facility would experience fewer conflict points compared to travelling on the existing US 26 through Sandy.

BENEFITS OR IMPACTS TO LOCAL BUSINESSES

Accounting for a city's unique characteristics and commercial competition outside the city is the only way to truly assess how a particular economy may be impacted by a new bypass. The City of Sandy is a mixed economic environment with local and big-box businesses. Many are auto-oriented and cater to highway pass-through traffic such as gas stations, convenience stores, drive-through coffee shops and fast food/high turnover restaurants. A major segment of retail customers are recreational visitors travelling through Sandy to Mt. Hood and Central Oregon. These unique customers support specialized local businesses such as outdoor equipment stores.

Some of these businesses serving pass through traffic may see an impact if their services cannot be easily replaced. For example, customers will need to determine if the travel time savings from taking the bypass outweighs the convenience of shopping in Sandy. Customers may choose to shop near their home before they leave or at their destination instead. Other existing auto-oriented businesses, such as gas stations, would likely be impacted by traffic diverted away from town and on to a bypass route. Customers may choose to stop for gas outside Sandy to save time travelling on the bypass. There are several gas stations to the east and west of Sandy within a few miles. The existing gas station at Firwood Road (Shorty's Corner) would be conveniently located on the east end of the bypass. Note that Sandy has a local gas tax that generates revenue to fund various transportation needs including facility maintenance. The diversion of vehicles to the bypass would likely reduce local gas tax revenue.

It is challenging to forecast the potential impact of the bypass to local businesses along US 26. With the forecasted local growth over the next 20 years, the associated local demand for goods and services could compensate for some of the business loss due to the bypass. However, the projected growth is based on the existing transportation system. With the bypass in place, the forecasted business growth along US 26 may decrease resulting in lower local demand for goods and services and an increased impact to future businesses. An analysis of employment data from 2018[3] (the most recent year available) showed that approximately 5,000 Sandy residents work outside of the city, 3,000 workers commute into the city, and 600 residents work within the city. Of the 3,600 jobs within Sandy, most are classified as retail trade (25%) followed by accommodation and food services (15%) and educational services (12%). Of these, retail and food services may be the most vulnerable to impacts from a bypass.

The majority of the bypass alignment is outside the urban growth boundary and would travel through areas with rural zoning and land uses. Urban development would be prohibited, eliminating the possibility for new commercial development along the bypass that could compete with existing businesses on US 26. The biggest commercial competition is found in the Portland Metro area, approximately seven miles west of Sandy, which can provide almost all the retail and service businesses highway drivers could need.

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[3] https://onthemap.ces.census.gov/

The bypass is forecasted to serve 1,500 vehicles peak hour in the 2040 peak hour. A portion of these vehicles are potential Sandy business customers that choose the travel time savings of the bypass over the convenience of shopping at a business on US 26. To counter that impact, lower traffic volumes on the highway may make downtown highway-fronting businesses more attractive for certain types of businesses.

US 26 JURISDICTIONAL TRANSFER TO THE CITY

A new bypass facility would be constructed and operated by ODOT. With the bypass in place, ODOT would transfer the jurisdiction of the existing section of US 26 being bypassed to the City. The ongoing maintenance and operation of the facility would be a cost burden for the City. This segment of US 26 is approximately 5 miles long with four to five travel lanes, street lighting, and numerous traffic signals. The average annual cost to maintain a comparable urban highway is $20,000 to $30,000 per mile. Over the next 20 years with inflation, the maintenance cost for the City is estimated to be $5 to $8 million.

The City taking jurisdiction of US 26 also brings opportunities to make local changes to the facility. Future traffic demand on the existing US 26 will decrease significantly with 1,500 vehicles during the peak hour diverting to the bypass. This demand reduction would potentially allow the reconstruction of the existing five-lane sections (outside the downtown couplet) to three-lanes and provide additional design features such as landscaping, wider sidewalks, protected bicycle lanes, median treatments, and diagonal parking with the extra roadway width. This would result in benefits to overall safety and livability and encourage more walking, biking, and transit activity. Reconstruction of US 26 would be a major capital project with potential modifications to traffic signals, drainage, utilities, street lighting, pavement markings and signage. Based on planning level cost estimates for comparable corridor reconstruction projects, the cost estimate could range from $20 to $40 million for improvements. When adjusted for inflation over the next 20 years, the corridor reconstruction cost estimate could range from $55 to $105 million. The conversion of US 26 to a three-lane facility could also significantly increase travel times through Sandy to the point it would be slower than Alternative #1. The safety and livability benefits should be balanced with the travel time impacts.

POLICY AND REGULATORY REQUIREMENTS

A detailed evaluation of the policy and regulatory considerations associated with a potential bypass was conducted for this analysis, as provided in the Appendix, Section 4 and summarized below.

The construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

A preferred bypass alternative would be documented in a facility plan, ultimately adopted by the Oregon Transportation Commission (OTC) and ODOT, thereby amending the Oregon Highway Plan (OHP). Planning for new bypasses is governed by OHP Policy 1G: Major Improvements and Policy 1H: Bypasses. Policy 1G states that existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. The construction of a new facility such as a bypass is categorized under the lowest level of priority under this policy. The planning process must demonstrate that alternatives that do not include a bypass cannot adequately support safety, growth management, and other livability and economic objectives.

Sandy and Clackamas County will need to work collaboratively on developing any necessary amendments to local plans (such as the comprehensive plan, TSPs, local land use, and subdivision codes) to ensure consistency with the facility plan for the proposed bypass. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities for the different levels of government are not the same.

Both Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. Local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. New ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that the access management, the land use management, and the coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County.

The preferred bypass alignment would most likely impact County land designated for EFU or Forest use and the County would need to support adoption with goal exception findings.[4] Following successful local adoption by the City and County, the facility plan could be presented to the OTC for its review and approval.

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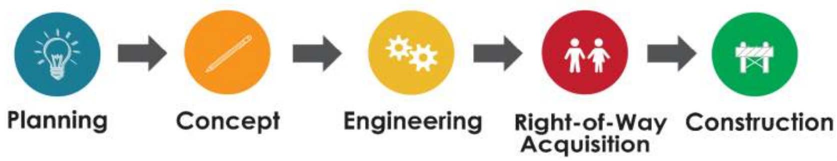
[4] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)

SCHEDULE AND FUNDING CONSIDERATIONS

Construction in 2040 is the soonest the bypass could reasonably be built due to the magnitude of the project. The general process for building a major infrastructure project is shown below. The primary challenges for the bypass project are related to regulations, acquiring right of way and funding that would likely extend the length of the process beyond 2040.



Major infrastructure projects use a wide variety of revenue and funding from federal, state, local, and private sources. Each phase of the project would likely be funded by multiple sources as they become available. ODOT receives about half a billion dollars from the Federal Highway Administration each year for construction projects on the state’s roads, including the interstate, as well as planning and engineering. The State Highway Fund, collected from local fees and taxes, can be used for both construction projects and the day-to-day maintenance and operations of the state’s roads.

The Statewide Transportation Improvement Program (STIP) is ODOT's capital improvement program for state and federally-funded projects. ODOT and the OTC allocate STIP funding to projects through a competitive process in coordination with a wide range of stakeholders and the public. The bypass project could be a candidate for the STIP Enhance program that funds projects to enhance or expand the transportation system. Area Commissions on Transportation recommend high-priority investments from state and local transportation plans in many of the Enhance programs. In addition, the Oregon legislature can pass a house bill to create new revenue sources and expand the state’s investment in transportation system improvements.

The Dundee Bypass is a recent example of a major infrastructure project in Oregon. Phase 1 of the project constructed a four-mile facility which opened in 2018 and cost $252 million. The $22.4 million funding for Phase 2 design came from House Bill 2017 passed by the Oregon Legislature. Construction of Phase 2 is estimated at $200 million but the source has not been identified.

TSP UPDATE PROCESS

The Sandy TSP is currently being updated and will consider the findings from this bypass reevaluation with the development of the revised motor vehicle projects and priorities. The TSP update will also assess the need for alternative mobility targets for US 26 at locations where meeting the existing ODOT mobility targets is infeasible or impractical based on specific criteria. If needed, alternative mobility targets will be developed as a TSP solution to address mobility and local growth objectives over the next 20 years. The bypass project is a potential long-term and unfunded TSP solution to address mobility and local growth objectives beyond 2040.

SUMMARY

To support the reevaluation of the US 26 bypass project, a planning-level assessment of the potential benefits and costs of the bypass was conducted with various measures of performance. The key findings are summarized in Table 1. These findings will contribute to TSP discussions and future decisions on pursuing the bypass concept.

TABLE 1: POTENTIAL COST AND BENEFIT SUMMARY OF BYPASS FACILITY

Measure	Cost/Impact	Benefit	Consideration
Project Planning and Construction Cost	Bypass would cost $980 million to $1 billion (in 2040 dollars) for construction, right-of-way acquisition, easements, design and construction management		The cost estimates are for planning purposes only and could change significantly due to the high level of uncertainty regarding the construction year, NEPA process and final design and alignment.
2040 Future Traffic Demand		Bypass is estimated to serve 1,500 vehicles during future peak hour. Existing US 26 is estimated to serve 2,300 vehicles during future peak hour.	Forecasting future demand estimated 40% of the total US 26 traffic would divert to the bypass facility.
2040 Future Travel Time		Adding the bypass to other Alternative #1 projects would save an additional 4 minutes and 30 seconds travelling eastbound and no savings travelling westbound on existing US 26. Under Alternative #3, the bypass would have shorter travel times compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.	Other roadway capacity projects are likely to be built by 2040 that would improve US 26 traffic flow and reduce the estimated time savings (5.5 minutes eastbound and 2.5 minutes westbound).
Travel Time Value		Save $6 million per year, $75 million over 20 years	Cost saving estimate is highly variable depending on future traffic patterns and duration of congested conditions.

Measure	Cost/Impact	Benefit	Consideration
Safety		Overall reduction in crashes on existing US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.	
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.	Current zoning and land use patterns encourage commercial development along the highway. A bypass outside the UGB would not allow for adjacent commercial development. If the bypass was inside the UGB, new adjacent commercial development may compete with businesses on US 26.
Jurisdictional Transfer to City	City would be responsible for US 26 maintenance after construction of the bypass, estimated to cost $5 to 8 million over 20 years. Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements could increase congestion and travel times through Sandy.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $55 to $105 million	City would need to find new ongoing funding for maintenance. The cost for reconstruction is highly variable due to uncertainty regarding the final design and year of construction.
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.		Amendments to the Oregon Highway Plan require adoption by the OTC and ODOT. A robust NEPA planning process will be needed to address potential impacts to Goal 5 resources and designated forest use lands.

APPENDIX

CONTENTS

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SECTION 1. EXISTING TRANSPORTATION SYSTEM PERFORMANCE MEMO

DKS 720 SW WASHINGTON STREET, SUITE 500, PORTLAND, OR 97205 • 503.243.3500 • DKSASSOCIATES.COM

EXISTING TRANSPORTATION SYSTEM PERFORMANCE

DATE: April 19, 2020

TO: Project Management Team

FROM: Reah Flisakowski, Kevin Chewuk, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the existing transportation conditions along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the existing transportation system performance documents the current vehicle travel conditions through the City and provides a framework to compare and evaluate the effectiveness of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of existing pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan.

MOTOR VEHICLE CONDITIONS

Current operating conditions for vehicles along US 26 through the City were assessed using data on existing vehicle travel behavior and volumes.[1] The data includes information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The following sections summarize this analysis.

TRAVEL PATTERN ANALYSIS

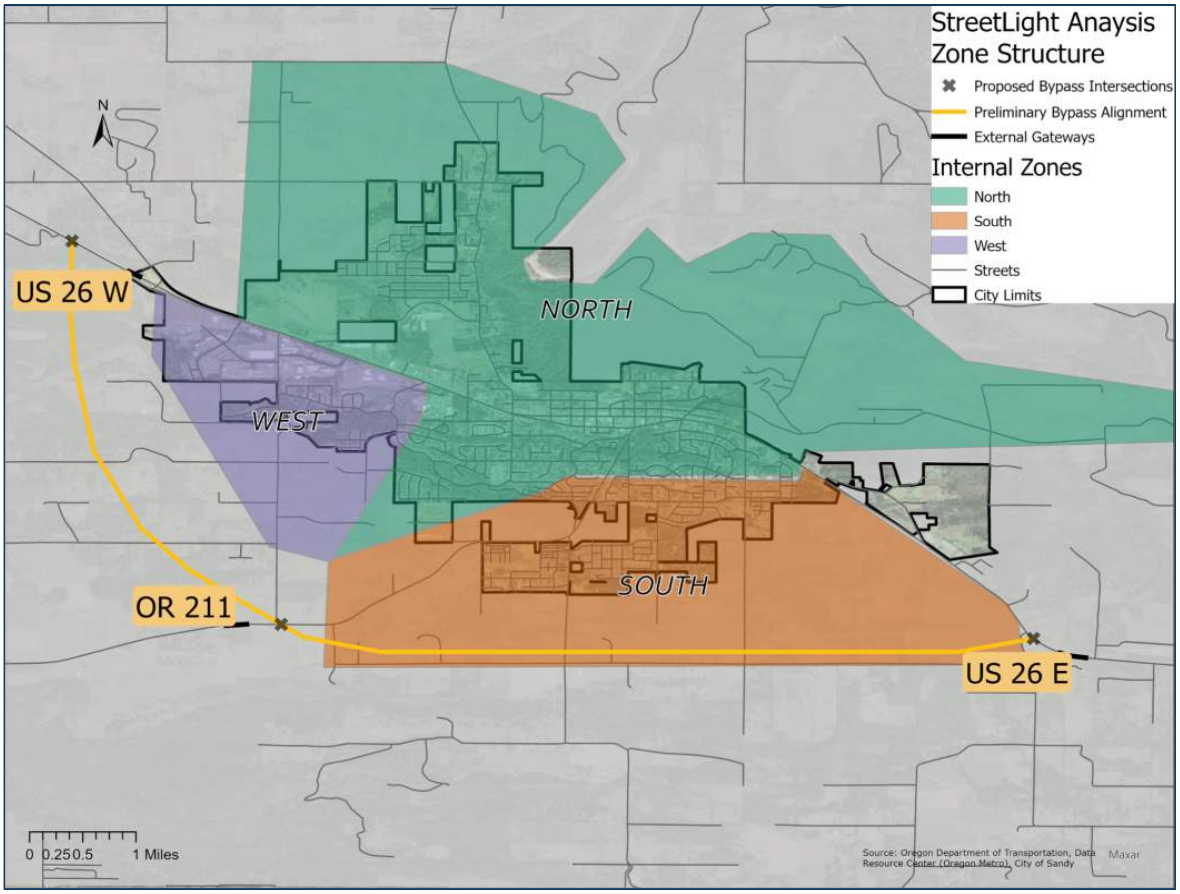
The travel pattern analysis was completed using StreetLight data. StreetLight data is a big data provider that aggregates a variety of location-based information and can provide insight into travel behavior. The StreetLight data was used to answer the following questions.

- What are the travel routes between highways (US 26 and OR 211) and various areas of the City?
- What is the typical travel time along US 26 through the City?

The zone structure shown in Figure 1 was used to evaluate these questions.

[1] Traffic counts were collected on October 22, 2020.

FIGURE 1: STREETLIGHT ZONE STRUCTURE



- The North zone covers the portion of Sandy that is not expected to use a future bypass due to the proposed route south of the City.
- The South and West zones cover areas that could potentially benefit from access to a future bypass.
- The three highway segment zones, shown as black lines in the map, capture the trips entering and exiting the study area. For example, the US 26 W zone represents all trips coming from or going to places west of that segment. All trips between these zones are expected to use a future bypass.

TRAVEL ROUTES

Table 1 shows a breakdown of the proportion of total p.m. peak period trips (4 p.m. to 6 p.m.) that travel between the zones. As shown, most trips in the p.m. peak come from the west, enter Sandy via US 26 and end at some location in the North analysis zone. Similarly, most trips are coming from or going to US 26 W or the North analysis zone indicating that these areas are attractive locations for drivers. The zones that generate the most trips are US 26 W and the North zone, with 34 percent and 24 percent respectively. These zones also generate the most trip destinations, with the North zone more attractive with 30 percent of the destinations, while US 26 W attracts 21 percent.

Some other key highlights include:

- Internal trips (between the North, South and West zones) = 23%
- External trips (between US 26 W, US 26 E and OR 211)[2] = 18%
- Trips entering or exiting Sandy = 59%
- Highest activity: between US 26 W and the North zone = 22%

TABLE 1: PROPORTION OF TOTAL PM PEAK TRIPS BETWEEN ZONES

	US 26 W	US 26 E	OR 211	NORTH	SOUTH	WEST	Origin Total
US 26 W	0%	6%	2%	14%	6%	6%	34%
US 26 E	6%	0%	1%	2%	0%	1%	10%
OR 211	1%	1%	0%	4%	2%	1%	9%
NORTH	8%	4%	3%	0%	5%	4%	24%
SOUTH	3%	0%	1%	5%	0%	1%	10%
WEST	3%	1%	2%	5%	2%	0%	13%
Destination Total	21%	12%	9%	30%	15%	13%	

The shaded cells in the table above represent the trips expected to use a future bypass.[3]

- The trips between the South zone and US 26 W, in either direction.
- Trips between the West zone and US 26 E, in either direction.

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[2] The sensitivity of this result was tested by looking at the proportion of external trips for an average 24-hour period, for a typical daily volume, including weekend days. This resulted in a small increase to 21 percent.

[3] Other origin-destination pairs in Table 1 are expected to remain on US 26 or use other local streets due the access restrictions assumed in the current configuration of the bypass. It is assumed that most drivers will avoid out-of-direction travel for local trips.

- Trips between the external highway zones (i.e., US 26 W, US 26 E and OR 211) are also expected to divert to the potential future bypass.

Based on these assumptions, a diversion proportion can be estimated at around 28 percent of the total p.m. peak period trips, which roughly correlates to 2,800 trips.

MOTOR VEHICLE OPERATIONS

Intersection turning movement counts were collected in October 2020. The ODOT traffic volume patterns report that monitors the impact of COVID-19 indicated that traffic volumes on US 26 were within five percent of 2019 volumes for the week counts were collected indicating that the collected counts were within a reasonable range and were appropriate to use for the subject analysis.

The methodology from the ODOT Analysis Procedures Manual was applied to determine the 30th highest annual hour volume (30 HV) for the study intersections. The 30 HV is commonly used for design purposes and represents the level of congestion that is typically encountered during the peak travel month.

To determine when the 30th highest annual hour volume occurs, data is examined from Automatic Traffic Recorder (ATR) stations that record highway traffic volumes year-round. If no on-site ATR is present, one with similar characteristics can be identified using ODOT's ATR Characteristics Table. If these do not produce a similar ATR with average annual daily traffic volumes (AADT) within 10% of study area volumes, the seasonal trend method should be used. The seasonal trend method averages seasonal trend groupings from the ATR Characteristics Table. For the study area, a nearby ATR (#26-033 US 26 near SE Powell Valley Road) was utilized to develop a calculated seasonal factor of 1.066. This factor was applied to the existing count data.

Jurisdictional Mobility Standards

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

[4] City of Sandy Transportation System Plan (2011)

Existing Intersection Operations

Motor vehicle conditions were evaluated during the 2020 p.m. peak hour at the 16 study intersections (shown in Table 2). The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. As shown, two intersections exceed current mobility targets, including the intersections of US 26 with Orient Drive and 362nd Drive. The US 26 intersection at Orient Drive serves high eastbound through traffic volumes and high southbound left traffic volumes that typically extend their green phases to the maximum length. These two movements are not served simultaneously so they require additional green time from the cycle that is not available resulting in the HCM analysis exceeding the mobility target. The US 26 intersection at 362nd Drive serves a high eastbound through volume that is approaching the available capacity of the existing timing and a high northbound left volume. Similar to the operations at US 26 and Orient Drive, these two movements require additional green time that is already allocated to other movements.

TABLE 2: EXISTING INTERSECTION OPERATIONS (2020)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	33	**0.90**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	28	**0.83**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	28	0.72
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	A [C]	8 [18]	0.24
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	D	32	0.70
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	27	0.73
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	36	0.79
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [B]	8 [15]	0.08
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.68
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	33	0.71
OR 211/ DUBARKO RD	TWSC	City of Sandy	D	A [D]	8 [29]	0.29
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	A [C]	9 [17]	0.36
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	31	0.58

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [F]	13 [63]	0.30
US 26/VISTA LOOP DRIVE W	TWSC	ODOT	0.80	B [C]	10 [19]	0.09
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [E]	10 [37]	0.05

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

CORRIDOR TRAVEL TIME

Using the StreetLight data and zone structure as depicted in Figure 1, an estimate of travel time along the US 26 corridor through Sandy was estimated for a typical weekday (Tuesday through Thursday) in the p.m. peak period (4 p.m. to 6 p.m.). This travel time estimate provides a baseline to compare benefits associated with a potential alternative highway route to the south of the City. Overall, the estimated total travel time (including intersection delay and segment travel time) is:

- Westbound total travel time: 9 minutes 54 seconds
- Eastbound total travel time:9 minutes 36 seconds

Corridor delay was also estimated to establish a baseline to compare against the future alternatives. The intersection delay, including the impact of queuing, was estimated at:

- Westbound intersection delay: 2 minutes 48 seconds
- Eastbound intersection delay: 3 minutes 10 seconds

This total intersection delay estimate, subtracted from the StreetLight travel time estimate, provided a road segment travel time estimate and average speed. This information provides a reasonableness check of the StreetLight data and a baseline travel time that can be used to estimate future conditions. For comparison, a vehicle traveling at the posted speed along the length of the study corridor, with no intersection delay, would average approximately 45 miles per hour (mph). As shown below, the StreetLight free-flow speeds for eastbound and westbound directions deviate only slightly from the 45-mph speed estimate.

- Westbound segment travel time: 7 minutes 6 seconds, 43 miles per hour
- Eastbound segment travel time: 6 minutes 26 seconds, 47 miles per hour

SUMMARY

The existing motor vehicle operations analysis revealed that two intersections in Sandy, US 26 and Orient Drive and US 26 and 362nd Drive do not meet mobility targets. At both intersections, the eastbound though volume is at or near the available capacity which has a significant impact on the overall operation of each intersection.

The StreetLight origin-destination (OD) analysis showed that most of the activity coming from the US 26 W zone, west of the City of Sandy, is destined for the North analysis zone, the area generally north of US 26 which is not expected to use a future bypass. However, these trips may benefit from the Bell Street extension to 362nd Drive that is currently in the design phase. With this improvement in place some trips that are destined for the North zone would be able to exit the US 26 corridor at the intersection with 362nd instead of continuing to Bluff Road.

The OD pairs that are expected to use the bypass, including the highway through trips and trips to and from zones near the proposed bypass connections comprise 28% of the total traffic during the p.m. peak period.

The findings above will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

APPENDIX

CONTENTS

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SHAPING A SMARTER TRANSPORTATION EXPERIENCE™

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SECTION 1. EXISTING CONDITION HCM REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	1790	5	5	1200	185	5	5	5	230	5	10
Future Volume (veh/h)	15	1790	5	5	1200	185	5	5	5	230	5	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	16	1946	5	5	1304	0	5	5	5	250	5	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	78	1940	865	77	1910		13	13	13	295	6	13
Arrive On Green	0.05	0.58	0.58	0.05	0.58	0.00	0.03	0.03	0.03	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	496	496	496	1579	32	69
Grp Volume(v), veh/h	16	1946	5	5	1304	0	15	0	0	266	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1489	0	0	1680	0	0
Q Serve(g_s), s	0.9	56.0	0.1	0.3	26.7	0.0	1.0	0.0	0.0	14.9	0.0	0.0
Cycle Q Clear(g_c), s	0.9	56.0	0.1	0.3	26.7	0.0	1.0	0.0	0.0	14.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.33	0.94		0.04
Lane Grp Cap(c), veh/h	78	1940	865	77	1910		38	0	0	314	0	0
V/C Ratio(X)	0.20	1.00	0.01	0.07	0.68		0.39	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	191	1940	865	188	1910		169	0	0	363	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	44.6	20.6	8.8	44.3	14.4	0.0	46.4	0.0	0.0	38.2	0.0	0.0
Incr Delay (d2), s/veh	0.8	21.1	0.0	0.2	1.3	0.0	2.4	0.0	0.0	15.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	22.7	0.0	0.1	8.3	0.0	0.4	0.0	0.0	7.4	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	45.4	41.7	8.8	44.5	15.7	0.0	48.8	0.0	0.0	53.2	0.0	0.0
LnGrp LOS	D	F	A	D	B		D	A	A	D	A	A
Approach Vol, veh/h		1967			1309	A		15			266	
Approach Delay, s/veh		41.7			15.8			48.8			53.2	
Approach LOS		D			B			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.5	60.0		22.2	8.5	60.0		6.5
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	10.5	53.0		20.0	10.5	53.0		10.5
Max Q Clear Time (g_c+I1), s	2.9	28.7		16.9	2.3	58.0		3.0
Green Ext Time (p_c), s	0.0	13.6		0.3	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	33.0
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰↰	↱
Traffic Volume (veh/h)	1415	340	265	1115	320	305
Future Volume (veh/h)	1415	340	265	1115	320	305
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1772	1772	1744	1744	1786	1786
Adj Flow Rate, veh/h	1505	362	282	1186	340	324
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	2	2	4	4	1	1
Cap, veh/h	1727	770	423	2688	431	578
Arrive On Green	0.51	0.51	0.25	0.81	0.13	0.13
Sat Flow, veh/h	3455	1502	1661	3400	3300	1514
Grp Volume(v), veh/h	1505	362	282	1186	340	324
Grp Sat Flow(s),veh/h/ln	1683	1502	1661	1657	1650	1514
Q Serve(g_s), s	54.3	21.4	21.0	14.5	13.8	0.0
Cycle Q Clear(g_c), s	54.3	21.4	21.0	14.5	13.8	0.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	1727	770	423	2688	431	578
V/C Ratio(X)	0.87	0.47	0.67	0.44	0.79	0.56
Avail Cap(c_a), veh/h	1732	773	423	2688	717	709
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.73	0.73	1.00	1.00
Uniform Delay (d), s/veh	29.6	21.6	46.1	3.8	58.1	33.5
Incr Delay (d2), s/veh	6.4	2.1	2.6	0.4	2.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	21.5	7.4	8.7	3.1	5.8	8.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	36.0	23.6	48.7	4.2	60.1	34.1
LnGrp LOS	D	C	D	A	E	C
Approach Vol, veh/h	1867			1468	664	
Approach Delay, s/veh	33.6			12.8	47.4	
Approach LOS	C			B	D	

Timer - Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	41.2	74.8				116.0		22.0
Change Period (Y+Rc), s	6.0	* 6				6.0		4.5
Max Green Setting (Gmax), s	25.0	* 69				98.0		29.5
Max Q Clear Time (g_c+I1), s	23.0	56.3				16.5		15.8
Green Ext Time (p_c), s	0.2	12.5				67.6		1.8

Intersection Summary	
HCM 6th Ctrl Delay	28.2
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Edition methodology expects strict NEMA phasing.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1615	5	25	1245	35	40	20	70	160	10	65
Future Volume (vph)	50	1615	5	25	1245	35	40	20	70	160	10	65
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1627		1624	1638	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	1676	3316		1644	3358	1471		1627		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1648	5	26	1270	36	41	20	71	163	10	66
RTOR Reduction (vph)	0	0	0	0	0	16	0	29	0	0	0	59
Lane Group Flow (vph)	51	1653	0	26	1270	20	0	103	0	86	87	7
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	18.7	96.2		5.0	82.5	82.5		13.7		15.7	15.7	15.7
Effective Green, g (s)	19.2	97.6		5.0	83.9	83.9		13.7		15.7	15.7	15.7
Actuated g/C Ratio	0.13	0.66		0.03	0.57	0.57		0.09		0.11	0.11	0.11
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	217	2186		55	1903	833		150		172	173	159
v/s Ratio Prot	0.03	c0.50		0.02	c0.38			c0.06		0.05	c0.05	
v/s Ratio Perm						0.01						0.00
v/c Ratio	0.24	0.76		0.47	0.67	0.02		0.69		0.50	0.50	0.04
Uniform Delay, d1	57.8	17.1		70.2	22.3	14.1		65.1		62.4	62.5	59.4
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	2.5		3.7	1.9	0.1		12.3		1.3	1.3	0.1
Delay (s)	58.1	19.6		73.9	24.2	14.1		77.3		63.8	63.8	59.5
Level of Service	E	B		E	C	B		E		E	E	E
Approach Delay (s)		20.8			24.9			77.3			62.6	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	27.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	148.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Edition methodology does not support turning movements with shared & exclusive lanes.

HCM Signalized Intersection Capacity Analysis
5: Ruben Lane & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	1630	110	40	1230	65	50	20	35	165	25	80
Future Volume (vph)	110	1630	110	40	1230	65	50	20	35	165	25	80
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.97	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1466	1644	3358	1431		1687	1461	1624	1649	1507
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.97	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1676	3318	1466	1644	3358	1431		1687	1461	1624	1649	1507
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	111	1646	111	40	1242	66	51	20	35	167	25	81
RTOR Reduction (vph)	0	0	28	0	0	25	0	0	32	0	0	74
Lane Group Flow (vph)	111	1646	83	40	1242	41	0	71	3	95	97	7
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases			2			6		8	8			4
Actuated Green, G (s)	12.6	92.1	92.1	9.7	89.2	89.2		13.7	13.7	13.1	13.1	13.1
Effective Green, g (s)	12.6	93.5	93.5	9.7	90.6	90.6		13.7	13.7	13.1	13.1	13.1
Actuated g/C Ratio	0.09	0.64	0.64	0.07	0.62	0.62		0.09	0.09	0.09	0.09	0.09
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	144	2124	938	109	2083	888		158	137	145	147	135
v/s Ratio Prot	0.07	c0.50		0.02	c0.37			c0.04		0.06	c0.06	
v/s Ratio Perm			0.06			0.03			0.00			0.00
v/c Ratio	0.77	0.77	0.09	0.37	0.60	0.05		0.45	0.02	0.66	0.66	0.05
Uniform Delay, d1	65.3	18.7	10.0	65.2	16.7	10.8		62.6	60.1	64.3	64.3	60.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.9	2.8	0.2	1.2	1.3	0.1		1.2	0.0	8.6	8.7	0.1
Delay (s)	86.2	21.6	10.2	66.4	18.0	10.9		63.8	60.1	72.9	73.0	60.9
Level of Service	F	C	B	E	B	B		E	E	E	E	E
Approach Delay (s)		24.7			19.0			62.6			69.4	
Approach LOS		C			B			E			E	

Intersection Summary			
HCM 2000 Control Delay	27.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	146.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱		↰	↱	
Traffic Volume (veh/h)	120	1570	150	65	1155	150	95	40	60	155	45	115
Future Volume (veh/h)	120	1570	150	65	1155	150	95	40	60	155	45	115
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	122	1602	153	66	1179	153	97	41	61	158	46	117
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	357	2036	907	83	1285	640	119	71	106	182	66	169
Arrive On Green	0.21	0.60	0.60	0.05	0.44	0.44	0.07	0.11	0.12	0.11	0.15	0.15
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	637	948	1701	445	1132
Grp Volume(v), veh/h	122	1602	153	66	1179	153	97	0	102	158	0	163
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1586	1701	0	1577
Q Serve(g_s), s	7.8	45.6	5.7	5.0	47.9	5.8	7.1	0.0	7.7	11.6	0.0	12.4
Cycle Q Clear(g_c), s	7.8	45.6	5.7	5.0	47.9	5.8	7.1	0.0	7.7	11.6	0.0	12.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.60	1.00		0.72
Lane Grp Cap(c), veh/h	357	2036	907	83	1285	640	119	0	178	182	0	235
V/C Ratio(X)	0.34	0.79	0.17	0.80	0.92	0.24	0.81	0.00	0.57	0.87	0.00	0.69
Avail Cap(c_a), veh/h	357	2036	907	143	1297	646	188	0	375	188	0	373
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.59	0.59	0.59	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	42.5	18.9	11.0	59.7	33.6	11.0	58.2	0.0	53.4	55.8	0.0	51.1
Incr Delay (d2), s/veh	0.2	1.9	0.2	10.1	11.8	0.9	9.7	0.0	1.8	31.2	0.0	2.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	16.8	2.0	2.4	19.0	3.0	3.4	0.0	3.2	6.6	0.0	5.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.7	20.8	11.3	69.8	45.4	11.8	67.9	0.0	55.1	87.0	0.0	53.4
LnGrp LOS	D	C	B	E	D	B	E	A	E	F	A	D
Approach Vol, veh/h		1877			1398			199			321	
Approach Delay, s/veh		21.5			42.9			61.4			69.9	
Approach LOS		C			D			E			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.4	80.8	12.9	22.9	31.7	59.5	17.6	18.2
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.0	4.5
Max Green Setting (Gmax), s	11.0	55.2	14.0	29.5	11.0	* 56	14.0	29.5
Max Q Clear Time (g_c+I1), s	7.0	47.6	9.1	14.4	9.8	49.9	13.6	9.7
Green Ext Time (p_c), s	0.0	7.3	0.0	0.5	0.0	5.7	0.0	0.3

Intersection Summary	
HCM 6th Ctrl Delay	35.5
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	75	210	250	5
Future Vol, veh/h	5	55	75	210	250	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	6	63	85	239	284	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	699	290	292	0	-	0
Stage 1	289	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	403	744	1275	-	-	-
Stage 1	756	-	-	-	-	-
Stage 2	666	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	374	742	1273	-	-	-
Mov Cap-2 Maneuver	374	-	-	-	-	-
Stage 1	704	-	-	-	-	-
Stage 2	665	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.7	2.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1273	-	374	742	-	-
HCM Lane V/C Ratio	0.067	-	0.015	0.084	-	-
HCM Control Delay (s)	8	0	14.8	10.3	-	-
HCM Lane LOS	A	A	B	B	-	-
HCM 95th %tile Q(veh)	0.2	-	0	0.3	-	-

Intersection	
Int Delay, s/veh	1.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	40	40	410	35	25	470
Future Vol, veh/h	40	40	410	35	25	470
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	43	43	436	37	27	500

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1009	457	0	0	473	0
Stage 1	455	-	-	-	-	-
Stage 2	554	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	264	599	-	-	1084	-
Stage 1	635	-	-	-	-	-
Stage 2	572	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	257	598	-	-	1084	-
Mov Cap-2 Maneuver	257	-	-	-	-	-
Stage 1	635	-	-	-	-	-
Stage 2	558	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.1	0	0.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	359	1084	-
HCM Lane V/C Ratio	-	-	0.237	0.025	-
HCM Control Delay (s)	-	-	18.1	8.4	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.1	-

Intersection	
Intersection Delay, s/veh	24.4
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	130	160	90	315	480	30
Future Vol, veh/h	130	160	90	315	480	30
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	138	170	96	335	511	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	16.1	21.3	31.5
HCM LOS	C	C	D

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	22%	45%	0%
Vol Thru, %	78%	0%	94%
Vol Right, %	0%	55%	6%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	405	290	510
LT Vol	90	130	0
Through Vol	315	0	480
RT Vol	0	160	30
Lane Flow Rate	431	309	543
Geometry Grp	1	1	1
Degree of Util (X)	0.696	0.529	0.842
Departure Headway (Hd)	5.813	6.168	5.584
Convergence, Y/N	Yes	Yes	Yes
Cap	616	580	646
Service Time	3.897	4.256	3.661
HCM Lane V/C Ratio	0.7	0.533	0.841
HCM Control Delay	21.3	16.1	31.5
HCM Lane LOS	C	C	D
HCM 95th-tile Q	5.5	3.1	9.2

Intersection	
Int Delay, s/veh	0.1

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Vol, veh/h	3	1055	850	5	5	0
Future Vol, veh/h	3	1055	850	5	5	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	1122	904	5	5	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	909	0	-	0	1474	455
Stage 1	-	-	-	-	907	-
Stage 2	-	-	-	-	567	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	745	-	-	-	117	552
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	531	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	745	-	-	-	117	552
Mov Cap-2 Maneuver	-	-	-	-	117	-
Stage 1	-	-	-	-	353	-
Stage 2	-	-	-	-	531	-

Approach	SE	NW	SW
HCM Control Delay, s	0	0	37.2
HCM LOS			E

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1
Capacity (veh/h)	-	-	745	-	117
HCM Lane V/C Ratio	-	-	0.004	-	0.045
HCM Control Delay (s)	-	-	9.9	-	37.2
HCM Lane LOS	-	-	A	-	E
HCM 95th %tile Q(veh)	-	-	0	-	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	155	995	15	270	45	0	0	35	25
Future Volume (veh/h)	0	0	0	155	995	15	270	45	0	0	35	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	0.99		1.00	1.00		0.99
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				168	1082	16	293	49	0	0	38	27
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				224	1520	23	354	49	0	0	262	186
Arrive On Green				0.52	0.52	0.52	0.27	0.27	0.00	0.00	0.27	0.27
Sat Flow, veh/h				434	2949	45	1076	180	0	0	960	682
Grp Volume(v), veh/h				661	0	605	342	0	0	0	0	65
Grp Sat Flow(s),veh/h/ln				1708	0	1721	1256	0	0	0	0	1642
Q Serve(g_s), s				33.6	0.0	28.9	26.6	0.0	0.0	0.0	0.0	3.3
Cycle Q Clear(g_c), s				33.6	0.0	28.9	29.9	0.0	0.0	0.0	0.0	3.3
Prop In Lane				0.25		0.03	0.86		0.00	0.00		0.42
Lane Grp Cap(c), veh/h				880	0	887	403	0	0	0	0	448
V/C Ratio(X)				0.75	0.00	0.68	0.85	0.00	0.00	0.00	0.00	0.15
Avail Cap(c_a), veh/h				1118	0	1126	403	0	0	0	0	448
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.91	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.1	0.0	19.9	41.6	0.0	0.0	0.0	0.0	30.3
Incr Delay (d2), s/veh				5.9	0.0	4.2	17.9	0.0	0.0	0.0	0.0	0.1
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				14.5	0.0	12.4	11.2	0.0	0.0	0.0	0.0	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				26.9	0.0	24.2	59.5	0.0	0.0	0.0	0.0	30.4
LnGrp LOS				C	A	C	E	A	A	A	A	C
Approach Vol, veh/h					1266			342			65	
Approach Delay, s/veh					25.6			59.5			30.4	
Approach LOS					C			E			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				34.0		60.7		34.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				30.0		72.0		30.0				
Max Q Clear Time (g_c+I1), s				5.3		35.6		31.9				
Green Ext Time (p_c), s				0.2		21.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			32.7									
HCM 6th LOS			C									

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱					↑	↱	↰	↑	
Traffic Volume (veh/h)	75	1310	365	0	0	0	0	240	125	25	185	0
Future Volume (veh/h)	75	1310	365	0	0	0	0	240	125	25	185	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1379	0				0	253	132	26	195	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	1777					0	580	484	33	663	0
Arrive On Green	0.54	0.54	0.00				0.00	0.33	0.33	0.01	0.13	0.00
Sat Flow, veh/h	178	3268	1502				0	1772	1480	1647	1730	0
Grp Volume(v), veh/h	781	677	0				0	253	132	26	195	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1480	1647	1730	0
Q Serve(g_s), s	39.9	33.8	0.0				0.0	12.3	7.2	1.7	11.2	0.0
Cycle Q Clear(g_c), s	39.9	33.8	0.0				0.0	12.3	7.2	1.7	11.2	0.0
Prop In Lane	0.10		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	959	915					0	580	484	33	663	0
V/C Ratio(X)	0.81	0.74					0.00	0.44	0.27	0.79	0.29	0.00
Avail Cap(c_a), veh/h	959	915					0	580	484	150	786	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	20.6	19.2	0.0				0.0	29.0	27.3	54.4	34.5	0.0
Incr Delay (d2), s/veh	7.6	5.4	0.0				0.0	2.4	1.4	22.2	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	17.8	14.1	0.0				0.0	5.5	2.7	0.9	5.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	28.1	24.5	0.0				0.0	31.4	28.7	76.6	34.7	0.0
LnGrp LOS	C	C					A	C	C	E	C	A
Approach Vol, veh/h		1458	A					385			221	
Approach Delay, s/veh		26.4						30.5			39.6	
Approach LOS		C						C			D	

Timer - Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		63.8		46.2			6.2	40.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8
Max Green Setting (Gmax), s		52.0		50.0			10.0	35.2
Max Q Clear Time (g_c+I1), s		41.9		13.2			3.7	14.3
Green Ext Time (p_c), s		8.6		0.5			0.0	1.1

Intersection Summary	
HCM 6th Ctrl Delay	28.6
HCM 6th LOS	C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
15: Wolf Drive/SE Ten Eyck Rd & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	160	1095	125	5	815	20	95	25	10	45	20	120
Future Volume (veh/h)	160	1095	125	5	815	20	95	25	10	45	20	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	168	1153	132	5	858	21	100	26	11	47	21	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	607	1607	716	399	1176	524	177	43	14	92	42	173
Arrive On Green	0.36	0.48	0.48	0.25	0.36	0.36	0.16	0.17	0.15	0.16	0.17	0.15
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	717	254	85	305	252	1032
Grp Volume(v), veh/h	168	1153	132	5	858	21	137	0	0	194	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1056	0	0	1589	0	0
Q Serve(g_s), s	7.8	29.9	5.5	0.3	25.3	1.0	2.2	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	7.8	29.9	5.5	0.3	25.3	1.0	14.8	0.0	0.0	12.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.73		0.08	0.24		0.65
Lane Grp Cap(c), veh/h	607	1607	716	399	1176	524	229	0	0	300	0	0
V/C Ratio(X)	0.28	0.72	0.18	0.01	0.73	0.04	0.60	0.00	0.00	0.65	0.00	0.00
Avail Cap(c_a), veh/h	607	2020	900	399	1793	800	261	0	0	335	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.0	22.8	16.5	31.4	30.3	22.6	44.7	0.0	0.0	43.9	0.0	0.0
Incr Delay (d2), s/veh	0.1	2.8	0.6	0.0	4.0	0.1	2.3	0.0	0.0	3.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	12.3	2.0	0.1	10.1	0.4	3.8	0.0	0.0	5.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.2	25.6	17.0	31.4	34.3	22.7	47.0	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	C	C	B	C	C	C	D	A	A	D	A	A
Approach Vol, veh/h		1453			884			137			194	
Approach Delay, s/veh		24.8			34.0			47.0			47.1	
Approach LOS		C			C			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	31.1	56.5		22.4	43.6	44.0		22.4				
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	10.5	66.0		19.5	15.5	61.0		19.5				
Max Q Clear Time (g_c+I1), s	2.3	31.9		14.7	9.8	27.3		16.8				
Green Ext Time (p_c), s	0.0	20.6		0.2	0.2	12.7		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			30.6									
HCM 6th LOS			C									

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	50	1050	850	0	5	20
Future Vol, veh/h	50	1050	850	0	5	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	6	6	0	0
Mvmt Flow	53	1105	895	0	5	21

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	895	0	-	0	1554	448
Stage 1	-	-	-	-	895	-
Stage 2	-	-	-	-	659	-
Critical Hdwy	4.16	-	-	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.23	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	748	-	-	-	106	564
Stage 1	-	-	-	-	364	-
Stage 2	-	-	-	-	482	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	748	-	-	-	98	564
Mov Cap-2 Maneuver	-	-	-	-	98	-
Stage 1	-	-	-	-	338	-
Stage 2	-	-	-	-	482	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	18.7
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	748	-	-	-	289
HCM Lane V/C Ratio	0.07	-	-	-	0.091
HCM Control Delay (s)	10.2	-	-	-	18.7
HCM Lane LOS	B	-	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	0.3

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	45	60	30	45	25	50	260	50	15	365	15
Future Vol, veh/h	10	45	60	30	45	25	50	260	50	15	365	15
Conflicting Peds, #/hr	1	0	0	0	0	1	4	0	1	1	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	125	-	-	125	-	-	-	-	-	-	-	325
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	2	2	2	2	2	2	3	3	3
Mvmt Flow	11	49	65	33	49	27	54	283	54	16	397	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	890	879	401	913	868	312	417	0	0	338	0	0
Stage 1	433	433	-	419	419	-	-	-	-	-	-	-
Stage 2	457	446	-	494	449	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.12	6.52	6.22	4.12	-	-	4.13	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.518	4.018	3.318	2.218	-	-	2.227	-	-
Pot Cap-1 Maneuver	266	288	653	254	290	728	1142	-	-	1216	-	-
Stage 1	605	585	-	612	590	-	-	-	-	-	-	-
Stage 2	587	577	-	557	572	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	207	265	651	185	267	727	1138	-	-	1215	-	-
Mov Cap-2 Maneuver	207	265	-	185	267	-	-	-	-	-	-	-
Stage 1	567	573	-	575	555	-	-	-	-	-	-	-
Stage 2	484	542	-	451	560	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18	21.5	1.2	0.3
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1138	-	-	207	401	185	345	1215	-	-
HCM Lane V/C Ratio	0.048	-	-	0.053	0.285	0.176	0.221	0.013	-	-
HCM Control Delay (s)	8.3	0	-	23.4	17.5	28.6	18.4	8	0	-
HCM Lane LOS	A	A	-	C	C	D	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.2	1.2	0.6	0.8	0	-	-

Intersection	
Int Delay, s/veh	4.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	240	60	210	235	35	115
Future Vol, veh/h	240	60	210	235	35	115
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	267	67	233	261	39	128

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	334	0	1028	301
Stage 1	-	-	-	-	301	-
Stage 2	-	-	-	-	727	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1231	-	260	741
Stage 1	-	-	-	-	753	-
Stage 2	-	-	-	-	480	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1231	-	211	741
Mov Cap-2 Maneuver	-	-	-	-	211	-
Stage 1	-	-	-	-	753	-
Stage 2	-	-	-	-	389	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.1	16.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	467	-	-	1231	-
HCM Lane V/C Ratio	0.357	-	-	0.19	-
HCM Control Delay (s)	16.9	-	-	8.6	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	1.6	-	-	0.7	-

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1085	85	20	845	25	20
Future Vol, veh/h	1085	85	20	845	25	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1154	90	21	899	27	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1244	0	1646	577
Stage 1	-	-	-	-	1154	-
Stage 2	-	-	-	-	492	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	534	-	92	465
Stage 1	-	-	-	-	267	-
Stage 2	-	-	-	-	586	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	534	-	88	465
Mov Cap-2 Maneuver	-	-	-	-	88	-
Stage 1	-	-	-	-	267	-
Stage 2	-	-	-	-	563	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	40.7
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	88	465	-	-	534	-
HCM Lane V/C Ratio	0.302	0.046	-	-	0.04	-
HCM Control Delay (s)	62.7	13.1	-	-	12	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	1.1	0.1	-	-	0.1	-

SECTION 2. FUTURE TRANSPORTATION SYSTEM PERFORMANCE MEMO

FUTURE TRANSPORTATION SYSTEM PERFORMANCE

DATE: June 28, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the future transportation system performance along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the future transportation system performance documents, the expected year 2040 vehicle travel conditions through the City and provides an evaluation of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of future pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan (TSP).

MOTOR VEHICLE CONDITIONS

Future year 2040 operating conditions for vehicles were assessed using data and findings developed for the existing conditions analysis[1] and available growth pattern data for the study area and US 26. The following sections summarize this analysis.

MOTOR VEHICLE ALTERNATIVES

Future improvement alternatives were previously developed and evaluated as part of the 2011 Sandy TSP[2] to enhance connectivity, provide access to developing lands, and address congestion in the US 26 corridor. The objective for each improvement alternative ranged from relying mainly on management and enhancement of the existing transportation system to large investments in new facilities to increase corridor capacity.

Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described in the following sections. Note the prior TSP Alternative #2 – US 26 Widening was not included in this analysis.

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[1] Existing Transportation System Performance memo, DKS Associates, April 19, 2021.

[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 NO BUILD ALTERNATIVE

A No Build Alternative would typically be based on the existing system and not include future improvements. However, there are several roadway projects that are fully funded and/or currently in the design phase. It was determined these projects should be included in the No Build Alternative due to the high level of certainty that they will be part of the future system. These projects are listed below. A figure showing the project locations by project ID is provided in the appendix.

- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to 362nd Avenue (portion of #3)
- Extend 362nd Avenue to Bell Street (portion of #4)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Signalized control at the intersection of OR 211 and Dubarko Road and US 26 and Vista Loop Drive (west)/Dubarko extension

2040 ALTERNATIVE #1 – LOCAL SYSTEM ENHANCEMENTS AND MINOR HIGHWAY IMPROVEMENTS

The emphasis of this alternative was to improve overall street connectivity, provide access to lands that would develop in the future, and improve operations on US 26 by enhancing the supporting City street network so that local trips would have less need to travel on US 26.

The future improvement projects included in the 2040 Alternative #1 are listed below. They include roadway and intersection capacity projects. A figure showing the project locations by project ID is provided in the appendix.

Roadway Improvements

- Industrial Way extension to Jarl Road/ US 26 (#1)
- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to Orient Drive (#3)
- Extend 362nd Drive to Kelso Road (#4)
- Extend Kate Schmidt Street from US 26 to the proposed Bell Street extension (#5)
- Extend Industrial Way north of US 26 to Bell Street Extension (#6)
- Extend Olson Road from 362nd Drive to Jewelberry Avenue (#7)
- Extend Agnes Street to Jewelberry Avenue (#8)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Gunderson Road, Sandy Heights St./370th Avenue, Colorado Road, Arletha Court (#10)
- Construct a new road from Dubarko Road to US 26 opposite Vista Loop Drive East (#11)

Intersection Improvements

- US 26/ 362nd Drive - Construct a second westbound left turn lane, receiving lane for second westbound left turn lane, northbound through lane, new southbound leg with through, right turn and left turn lane
- US 26/ Industrial Way – Change southbound approach to dual left turn lanes and a shared through/right lane, construct a northbound left turn lane
- US 26/Ruben Lane - Change southbound approach to dual left turn lanes and a shared through/right lane, change northbound approach to left turn lane, and shared through/right lane
- OR 211/ Proctor Boulevard (US 26) – Construct a northbound left turn lane (restriping only)
- US 26/ Ten Eyck Road/Wolf Drive – Construct a northbound and southbound left turn lane
- US 26/ Vista Loop Drive West – Realign Vista Loop Drive to be perpendicular to US 26
- OR 211/ Dubarko Road - Construct a traffic signal, northbound right turn lane, southbound left turn lane, northbound left turn lane
- OR 211/ Bornstedt Road – Prohibit left turn movements out
- OR 211/ Arletha Court - Realign intersection to create a four-legged intersection with the Gunderson Road extension
- 362nd Drive/ Industrial Way (West) - Construct an eastbound left turn lane with 50 feet of storage
- 362nd Drive/ Dubarko Road - Construct a single-lane roundabout

2040 ALTERNATIVE #3 – LOCAL SYSTEM ENHANCEMENTS AND US 26 BYPASS

Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner. A figure showing the high-level conceptual alignment of the bypass (#13) is provided in the appendix.

For the purpose of this analysis, the bypass concept was assumed to have the following design characteristics:

- Four-lane facility (two lanes in each direction)
- 45 mph posted speed and 50 mph design speed
- Limited access facility
    - interchange at the east and west end connections with US 26
    - at-grade intersection at OR 211 controlled by a traffic signal or roundabout
    - remaining key street intersections limited to right-in/right-out

The bypass conceptual alignment and design characteristics will be further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

MOTOR VEHICLE OPERATIONS

FUTURE FORECASTING

Traffic forecasts for each of the future 2040 alternatives were developed using a combination of available data and prior modeling analysis and findings. The forecasts relied on recent year 2020 intersection counts[3], year 2029 analysis from the 2011 Sandy TSP and ODOT Volume Tables. The forecasts were developed for the TSP study intersections and focused on the peak hour. Future volumes can be found in the operation reports in the appendix.

Future 2040 No Build Alternative forecasts were based on the 2020 count data and growth rates available from the 2029 forecasts. The addition of the Alternative #1 improvements would result in moderate changes to local travel patterns with better connectivity and intersection capacity. The 2040 No Build Alternative forecasts were refined to represent the 2040 Alternative #1 using growth rates available from the 2029 forecasts.

The addition of the bypass would result in significant changes to regional travel patterns. Future 2040 Alternative #3 forecasts were developed using the Alternative #1 volumes, growth rates available from the 2029 forecasts and current travel pattern data.

A travel pattern analysis was completed using StreetLight data which provided information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The data showed the proposed bypass would attract up to 28% of the total US 26 traffic during the peak hour. For a conservative analysis and for alignment with the 2011 Sandy TSP findings, the forecasting assumed 40% of the total US 26 traffic would divert to the bypass.

The 2040 Alternative #1 volumes were adjusted to account for use of the US 26 bypass to develop 2040 Alternative #3 volumes. US 26 is forecasted to serve approximately 3,800 vehicles during the peak hour under the 2040 No Build Alternative. Under the 2040 Alternative #3, US 26 is forecasted to serve approximately 2,300 vehicles and the bypass is forecasted to serve approximately 1,500 vehicles during the peak hour.

JURISDICTIONAL MOBILITY STANDARDS

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better

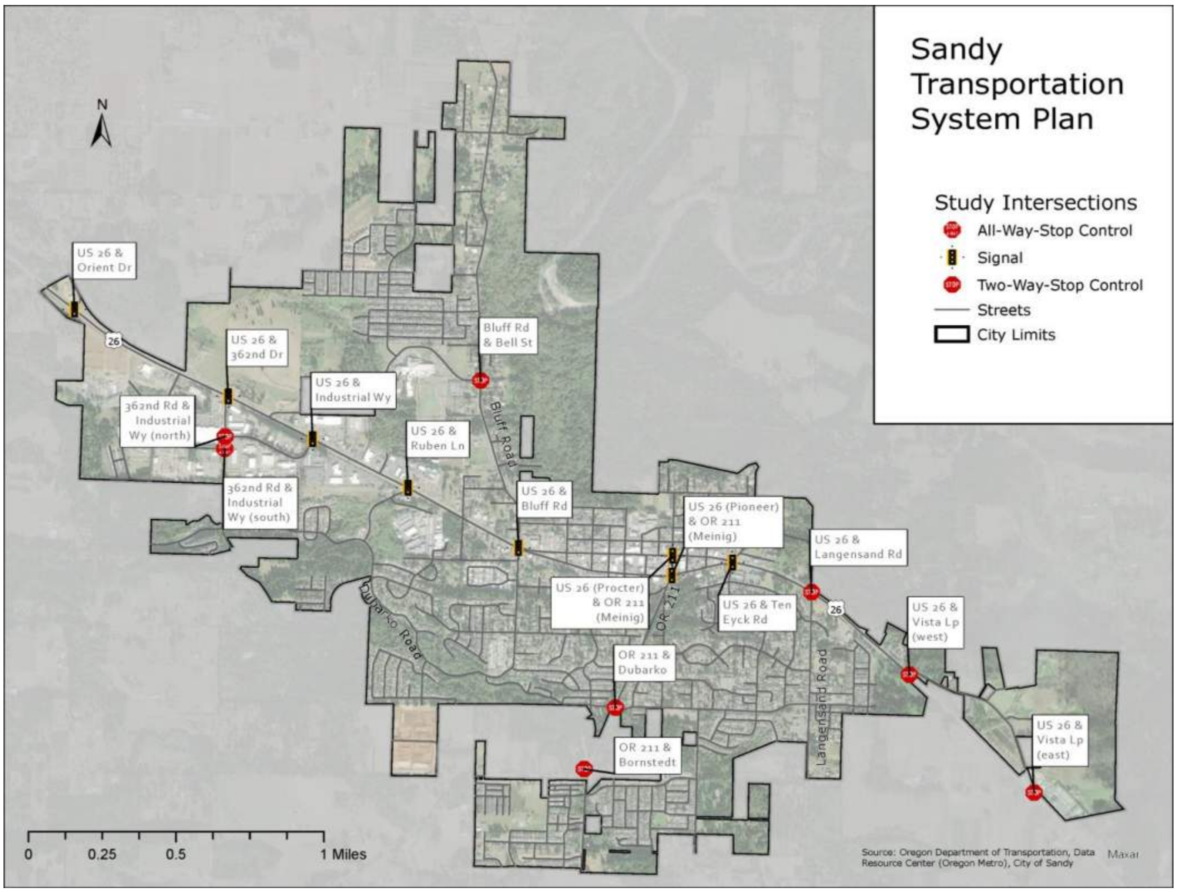
[3] Traffic counts were collected on October 22, 2020.

be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

FUTURE INTERSECTION OPERATIONS

Motor vehicle conditions were evaluated for the 2040 peak hour at the 16 study intersections under each of the future improvement alternatives. The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. The detailed intersection operation reports are shown in the appendix.

FIGURE 1: STUDY INTERSECTIONS WITH EXISTING CONTROL



[4] City of Sandy Transportation System Plan, DKS Associates, 2011.

2040 No Build

As shown in Table 1, eight intersections are forecasted to exceed mobility targets.

- **US 26 and Orient Drive** – The eastbound through movement at this intersection requires more capacity but is limited by the split phasing for Orient Drive/Jarl Road which serves a high southbound left turn volume with only a single approach lane.
- **US 26 and 362nd Drive** – More capacity is needed for the eastbound and westbound left and through movements at this intersection but green time for those movements is limited by the split phasing of the northbound and southbound approaches.
- **US 26 and Industrial Way** – The eastbound through movement and northbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **362nd Drive and Industrial Way (north)** – High northbound and southbound volumes result in limited gaps for the Industrial Way approach at this two-way-stop-controlled intersection.
- **362nd Drive and Industrial Way (south)** – High traffic volumes at all approaches result in long delays for all movements at this all-way-stop-controlled intersection.
- **US 26 and Ruben Lane** - The eastbound through movement and southbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **US 26 and Bluff Road** – The eastbound left and through, westbound left and through, and northbound left movements are all over capacity at this intersection.
- **OR 211 and Bornstedt Road** - High eastbound and westbound volumes result in limited gaps for the Bornstedt Road approach at this two-way-stop-controlled intersection.

TABLE 1: 2040 NO BUILD INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.19**
US 26/362ND DRIVE	Signal	ODOT	0.80	F	121	**1.16**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	E	74	**1.10**
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**B [F]**	11 [117]	0.49 [0.94]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	214	1.43
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	35	**0.97**
US 26/BLUFF ROAD	Signal	ODOT	0.85	F	112	**1.12**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	9 [23]	0.29 [0.09]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	30	0.81
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.84
OR 211/ DUBARKO ROAD	Signal	City of Sandy	D	C	21	0.81
OR 211/BORNSTEDT ROAD	TWSC	City of Sandy	D	**A [F]**	10 [240]	0.35 [1.32]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	29	0.80
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	16 [>300]	0.48 [0.91]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	C	25	0.66
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [117]	0.48 [0.25]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

2040 Alternative #1

The improvements included in Alternative 1 were analyzed to assess operation benefits at the study intersections resulting from new system network and added capacity. Two intersections that did not meet mobility targets will do so with the improvements in Alternative #1.

- The intersection of US 26 and Industrial Way meets mobility targets with a reduction in demand at the eastbound, westbound and northbound approaches.
- The intersection of OR 211 and Bornstedt Road meets mobility targets with the prohibition of the northbound left turn movement.

Operations under Alternative #1 conditions are show in Table 2. With the new local network connections north of US 26, particularly the Bell Street extension to Orient Drive, through volumes along US 26 are reduced in Alternative #1 which results in improvements to the operation of intersections along the highway.

Six intersections still fail to meet mobility targets under Alternative #1.

- **US 26 and Orient Drive** – There is a higher eastbound left traffic volume and lower eastbound through volume relative to the No Build condition however this reduction does not improve conditions enough for this intersection to meet mobility targets.
- **US 26 and 362nd Drive** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **362nd Drive and Industrial Way (north)** – With an additional southbound through lane that widens this intersection and increased traffic volumes, conditions remain LOS F for the Industrial Way approach.
- **362nd Drive and Industrial Way (south)** – The eastbound left turn lane improves conditions for that approach, but higher northbound and southbound volumes degrade conditions for the major approaches.
- **US 26 and Ruben Lane** - Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **US 26 and Bluff Road** – Lower traffic volumes for the eastbound left and through and westbound through movements improve conditions at this intersection but it still fails to meet mobility targets.

TABLE 2: 2040 ALTERNATIVE #1 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.11**
US 26/362ND DRIVE	Signal	ODOT	0.80	D	41	**1.00**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	D	18	0.79
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**A [F]**	10 [107]	0.46 [1.04]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	>300	1.52
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	D	48	**0.84**
US 26/BLUFF ROAD	Signal	ODOT	0.85	E	73	**0.86**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	8 [16]	0.24 [0.10]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.80
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.72
OR 211/ DUBARKO RD	Signal	City of Sandy	D	B	16	0.68
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	B [B]	11 [15]	0.5 [0.04]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	28	0.73
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	18 [>300]	0.51 [1.21]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	B	17	0.61
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [121]	0.48 [0.26]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

Alternative #3

The improvements included in Alternative 1, combined with the bypass of the existing US 26 corridor, were analyzed to assess operation benefits at the study intersections. Because the impacts on the City street network will vary significantly with the locations and types of access allowed to the bypass, only the US 26 corridor intersections were evaluated to see how much the bypass could relieve congestion.

As shown in Table 3, with the addition of a US 26 bypass only the intersection of US 26 and Orient Drive would exceed mobility targets. The eastbound through and southbound left movements at this intersection continue to compete for available green time in the cycle even with the addition of the bypass.

TABLE 3: 2040 ALTERNATIVE #3 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	32	**0.83**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	34	0.76
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	22	0.56
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	31	0.65
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	42	0.64
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.59
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.67
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	26	0.54
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [D]	10 [33]	0.25 [0.17]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	A	4	0.48
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [F]	10 [62]	0.28 [0.14]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

MOTOR VEHICLE TRAVEL TIME ESTIMATES

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the year 2040 peak hour. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the southern end of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 4 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 4: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:36	09:54
2040 NO BUILD		16:49	14:26
2040 ALTERNATIVE #1		13:18	10:15
2040 ALTERNATIVE #3	US 26 FACILITY	08:54	10:19
	BYPASS FACILITY	07:56	07:56

BYPASS FACILITY CROSS-SECTION CONSIDERATION

The expected 2040 peak hour volumes using the bypass suggest the facility could adequately accommodate demands with a narrower cross-section providing 2 lanes (one in each direction). The highest 2040 volume on the bypass is not expected to exceed 1,000 vehicles in either direction. If the bypass concept was reduced to a 2- lane facility, the connection with OR 211 may require a full interchange instead of an at-grade intersection with traffic signal or roundabout control. The analysis and findings in this future conditions memo would not change since free-flow operations are expected on the bypass with either 2 or 4 lanes and the same future volumes would be served. Both cross-sections options will be considered and further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

SUMMARY

The future conditions findings from this analysis will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- The addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern end of Sandy.
- Compared to the 2040 No Build Alternative, the addition of local connections and intersection improvements under 2040 Alternative #1 would decrease travel times on US 26 approximately 3 minutes 30 seconds eastbound and 4 minutes westbound
- Compared to the 2040 No Build Alternative, the addition of the bypass under 2040 Alternative #3 would decrease travel times on US 26 approximately 8 minutes eastbound and 4 minutes westbound
- Under Alternative #3, the bypass would save travel time through the study area compared to US 26 (1 minute eastbound and 2 minutes 30 seconds westbound)

APPENDIX

CONTENTS

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SECTION 1. FUTURE ROADWAY

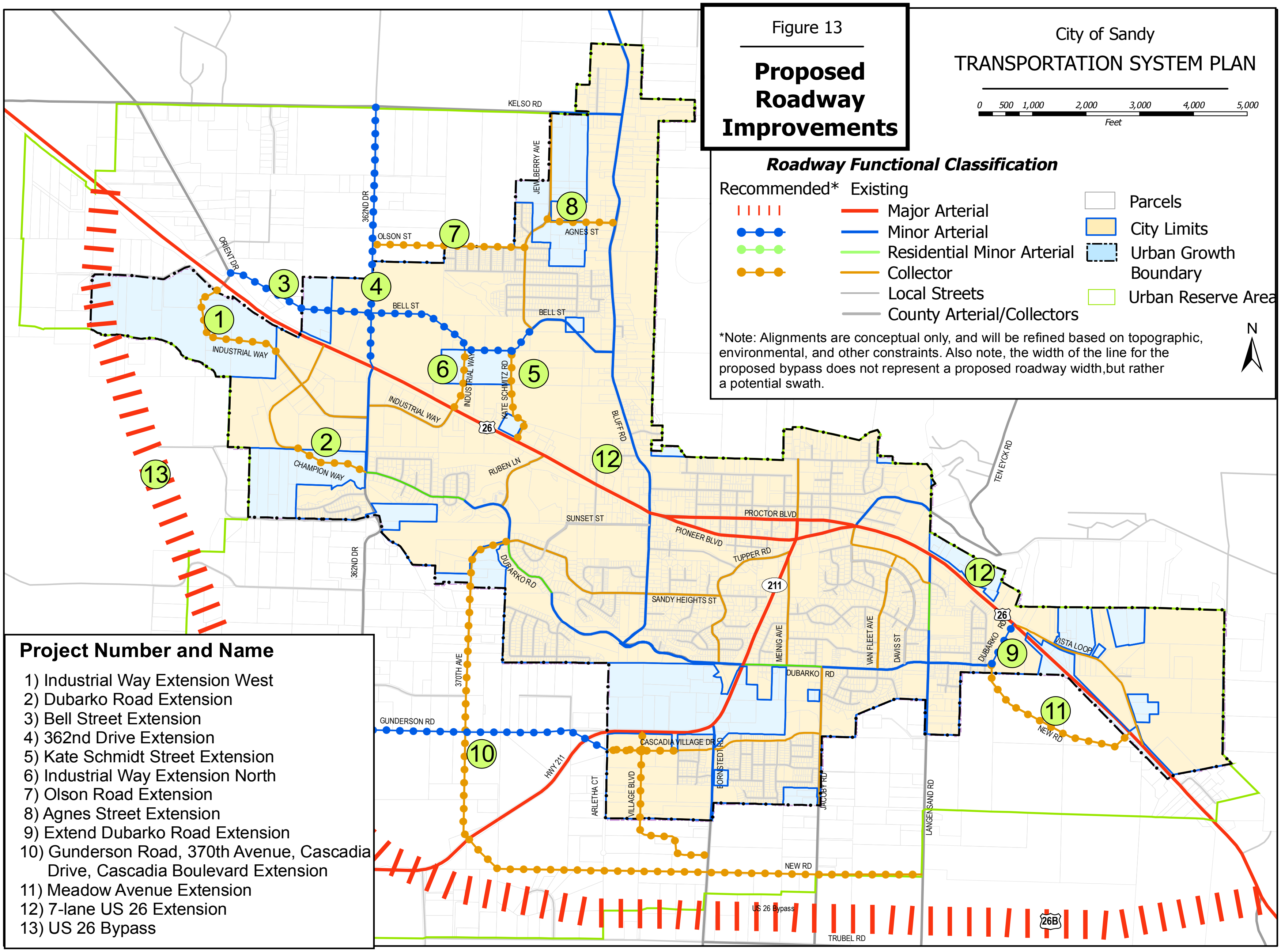


Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
0 500 1,000 2,000 3,000 4,000 5,000
Feet
Roadway Functional Classification
Recommended* Existing
Major Arterial
Minor Arterial
Residential Minor Arterial
Collector
Local Streets
County Arterial/Collectors
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
*Note: Alignments are conceptual only, and will be refined based on topographic, environmental, and other constraints. Also note, the width of the line for the proposed bypass does not represent a proposed roadway width,but rather a potential swath.
N
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
KELSO RD
OLSON ST
AGNES ST
BELL ST
ORIENT DR
362ND DR
JEWELBERRY AVE
INDUSTRIAL WAY
CHAMPION WAY
RUBEN LN
KATE SCHMITZ RD
BLUFF RD
SUNSET ST
PROCTOR BLVD
PIONEER BLVD
TUPPER RD
SANDY HEIGHTS ST
DUBARKO RD
MEINIG AVE
VAN FLEET AVE
DAVIS ST
VISTA LOOP
NEW RD
TEN EYCK RD
GUNDERSON RD
370TH AVE
HWY 211
ARLETHA CT
VILLAGE BLVD
CASCADIA VILLAGE DR
BORNSTEDT RD
JACOBY RD
LANGENSAND RD
US 26 Bypass
TRUBEL RD
26
211
26B

SECTION 2. FUTURE CONDITION HCM REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Future Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	63	2653	5	11	1842	0	11	53	11	274	11	21
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	81	1907	850	65	1847		14	69	14	288	12	22
Arrive On Green	0.05	0.57	0.57	0.04	0.56	0.00	0.07	0.06	0.07	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	227	1096	227	1501	60	115
Grp Volume(v), veh/h	63	2653	5	11	1842	0	75	0	0	306	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1551	0	0	1676	0	0
Q Serve(g_s), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Cycle Q Clear(g_c), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.15		0.15	0.90		0.07
Lane Grp Cap(c), veh/h	81	1907	850	65	1847		98	0	0	321	0	0
V/C Ratio(X)	0.78	1.39	0.01	0.17	1.00		0.76	0.00	0.00	0.95	0.00	0.00
Avail Cap(c_a), veh/h	81	1907	850	80	1847		101	0	0	321	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	54.0	24.9	10.8	53.3	25.3	0.0	52.8	0.0	0.0	45.9	0.0	0.0
Incr Delay (d2), s/veh	35.6	179.5	0.0	0.7	20.2	0.0	24.9	0.0	0.0	37.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	69.1	0.1	0.3	26.1	0.0	2.8	0.0	0.0	12.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	89.7	204.4	10.8	54.1	45.5	0.0	77.7	0.0	0.0	83.5	0.0	0.0
LnGrp LOS	F	F	B	D	D		E	A	A	F	A	A
Approach Vol, veh/h		2721			1853	A		75			306	
Approach Delay, s/veh		201.3			45.6			77.7			83.5	
Approach LOS		F			D			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	68.0		26.0	8.5	69.0		11.3
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	5.0	61.0		21.0	5.0	61.0		7.0
Max Q Clear Time (g_c+I1), s	6.2	65.6		22.7	2.7	67.0		7.5
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	133.9
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Future Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
Arrive On Green	0.08	0.37	0.36	0.16	0.56	0.54	0.23	0.23	0.23	0.14	0.14	0.14
Sat Flow, veh/h	1688	3367	1502	1661	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Cycle Q Clear(g_c), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
V/C Ratio(X)	1.59	1.35	0.50	1.08	1.15	0.44	0.46	0.39	1.00	0.67	0.74	0.85
Avail Cap(c_a), veh/h	198	1243	884	258	1397	820	761	402	343	376	395	335
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.20	0.20	0.20	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	41.0	15.6	52.8	28.5	13.2	43.1	42.7	50.2	53.1	53.7	54.6
Incr Delay (d2), s/veh	290.0	165.0	2.0	50.9	68.8	0.3	0.3	0.4	47.8	2.4	3.3	9.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	20.4	47.0	12.5	11.3	30.1	6.0	4.9	4.3	15.5	5.1	6.0	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	327.3	206.0	17.6	103.7	97.4	13.5	43.3	43.0	98.0	55.5	56.9	64.1
LnGrp LOS	F	F	B	F	F	B	D	D	F	E	E	E
Approach Vol, veh/h		2442			2242			853			521	
Approach Delay, s/veh		187.6			84.8			65.2			59.0	
Approach LOS		F			F			E			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	21.8	52.0		22.2	15.0	58.8		34.0				
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5				
Max Green Setting (Gmax), s	7.0	* 46		29.0	11.0	42.0		29.5				
Max Q Clear Time (g_c+I1), s	17.8	50.0		17.1	13.0	56.8		31.4				
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			121.2									
HCM 6th LOS			F									

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Future Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1620		1624	1638	1508
Flt Permitted	0.06	1.00		0.06	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	100	3316		101	3358	1471		1620		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	66	1985	5	26	1832	51	173	36	255	235	15	173
RTOR Reduction (vph)	0	0	0	0	0	23	0	33	0	0	0	112
Lane Group Flow (vph)	66	1990	0	26	1832	28	0	431	0	125	125	61
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						4
Actuated Green, G (s)	74.3	70.3		71.1	68.7	68.7		22.6		17.3	17.3	17.3
Effective Green, g (s)	75.3	71.7		71.1	70.1	70.1		22.6		17.3	17.3	17.3
Actuated g/C Ratio	0.58	0.55		0.55	0.54	0.54		0.17		0.13	0.13	0.13
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	112	1828		83	1810	793		281		216	217	200
v/s Ratio Prot	c0.02	c0.60		0.01	0.55			c0.27		c0.08	0.08	
v/s Ratio Perm	0.32			0.16		0.02						0.04
v/c Ratio	0.59	1.09		0.31	1.01	0.03		1.53		0.58	0.58	0.31
Uniform Delay, d1	56.5	29.1		59.7	30.0	14.1		53.7		52.9	52.9	50.9
Progression Factor	0.43	0.45		0.79	0.67	2.57		1.00		1.00	1.00	1.00
Incremental Delay, d2	2.8	45.0		0.8	19.5	0.0		257.3		2.8	2.7	0.5
Delay (s)	27.4	58.1		47.8	39.4	36.2		311.0		55.7	55.6	51.4
Level of Service	C	E		D	D	D		F		E	E	D
Approach Delay (s)		57.1			39.5			311.0			53.9	
Approach LOS		E			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	74.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	102.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: Ruben Lane & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Future Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1467	1644	3358	1432		1682	1461	1624	1646	1506
Flt Permitted	0.07	1.00	1.00	0.06	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (perm)	132	3318	1467	96	3358	1432		1682	1461	1624	1646	1506
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	177	2066	197	45	1667	101	121	35	40	273	35	136
RTOR Reduction (vph)	0	0	40	0	0	36	0	0	34	0	0	126
Lane Group Flow (vph)	177	2066	157	45	1667	65	0	156	6	153	155	10
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		2	6		6		8	8			4
Actuated Green, G (s)	81.5	80.1	80.1	75.5	75.5	75.5		19.3	19.3	10.0	10.0	10.0
Effective Green, g (s)	81.5	81.5	81.5	75.5	76.9	76.9		19.3	19.3	10.0	10.0	10.0
Actuated g/C Ratio	0.63	0.63	0.63	0.58	0.59	0.59		0.15	0.15	0.08	0.08	0.08
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	175	2080	919	93	1986	847		249	216	124	126	115
v/s Ratio Prot	0.06	c0.62		0.01	c0.50			c0.09		c0.09	0.09	
v/s Ratio Perm	c0.57		0.11	0.27		0.05			0.00			0.01
v/c Ratio	1.01	0.99	0.17	0.48	0.84	0.08		0.63	0.03	1.23	1.23	0.09
Uniform Delay, d1	42.5	24.0	10.1	30.2	21.5	11.4		52.0	47.3	60.0	60.0	55.8
Progression Factor	0.66	0.41	0.29	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.3	4.6	0.0	2.3	4.5	0.2		3.9	0.0	156.7	154.7	0.2
Delay (s)	51.1	14.5	2.9	32.5	26.0	11.5		55.9	47.4	216.7	214.7	56.0
Level of Service	D	B	A	C	C	B		E	D	F	F	E
Approach Delay (s)		16.2			25.4			54.2			166.8	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱		↰	↱	
Traffic Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Future Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	291	1949	158	97	1459	250	148	56	122	158	46	260
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	247	1681	748	75	1150	572	139	78	170	250	53	299
Arrive On Green	0.15	0.50	0.50	0.05	0.39	0.39	0.08	0.16	0.16	0.15	0.23	0.23
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	493	1075	1701	232	1313
Grp Volume(v), veh/h	291	1949	158	97	1459	250	148	0	178	158	0	306
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1569	1701	0	1546
Q Serve(g_s), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Cycle Q Clear(g_c), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.69	1.00		0.85
Lane Grp Cap(c), veh/h	247	1681	748	75	1150	572	139	0	248	250	0	352
V/C Ratio(X)	1.18	1.16	0.21	1.30	1.27	0.44	1.06	0.00	0.72	0.63	0.00	0.87
Avail Cap(c_a), veh/h	247	1681	748	75	1150	572	139	0	428	250	0	422
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.13	0.13	0.13	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	46.9	27.5	15.4	52.5	33.5	24.6	50.5	0.0	43.8	44.1	0.0	40.7
Incr Delay (d2), s/veh	85.1	72.7	0.1	202.2	128.1	2.4	94.2	0.0	2.4	4.4	0.0	14.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.4	37.1	2.2	6.3	35.5	5.2	7.5	0.0	4.8	4.4	0.0	9.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	132.0	100.2	15.5	254.7	161.6	27.0	144.7	0.0	46.2	48.5	0.0	54.9
LnGrp LOS	F	F	B	F	F	C	F	A	D	D	A	D
Approach Vol, veh/h		2398			1806			326			464	
Approach Delay, s/veh		98.5			148.0			90.9			52.7	
Approach LOS		F			F			F			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.0	58.9	13.0	29.1	20.9	47.0	20.7	21.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.5	* 4.5
Max Green Setting (Gmax), s	5.0	49.2	9.0	29.5	12.0	* 43	9.0	* 30
Max Q Clear Time (g_c+I1), s	7.0	56.9	11.0	22.9	18.1	45.0	11.6	13.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.6

Intersection Summary	
HCM 6th Ctrl Delay	111.7
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	1.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	100	465	405	5
Future Vol, veh/h	5	55	100	465	405	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	58	105	489	426	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1131	432	433	0	-	0
Stage 1	431	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	223	619	1132	-	-	-
Stage 1	651	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	201	617	1130	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.4	1.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1130	-	201	617	-	-
HCM Lane V/C Ratio	0.093	-	0.026	0.094	-	-
HCM Control Delay (s)	8.5	0	23.4	11.4	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.1	0.3	-	-

Intersection	
Int Delay, s/veh	10.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	80	575	210	190	530
Future Vol, veh/h	55	80	575	210	190	530
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	58	84	605	221	200	558

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1674	718	0	0	826	0
Stage 1	716	-	-	-	-	-
Stage 2	958	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	104	426	-	-	800	-
Stage 1	481	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	78	425	-	-	800	-
Mov Cap-2 Maneuver	78	-	-	-	-	-
Stage 1	481	-	-	-	-	-
Stage 2	277	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	116.9	0	2.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	151	800	-
HCM Lane V/C Ratio	-	-	0.941	0.25	-
HCM Control Delay (s)	-	-	116.9	11	-
HCM Lane LOS	-	-	F	B	-
HCM 95th %tile Q(veh)	-	-	6.8	1	-

Intersection	
Intersection Delay, s/veh	133.5
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	230	125	605	555	30
Future Vol, veh/h	180	230	125	605	555	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	189	242	132	637	584	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	35.2	214.3	101.6
HCM LOS	E	F	F

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	17%	44%	0%
Vol Thru, %	83%	0%	95%
Vol Right, %	0%	56%	5%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	730	410	585
LT Vol	125	180	0
Through Vol	605	0	555
RT Vol	0	230	30
Lane Flow Rate	768	432	616
Geometry Grp	1	1	1
Degree of Util (X)	1.407	0.809	1.116
Departure Headway (Hd)	6.863	7.495	7.139
Convergence, Y/N	Yes	Yes	Yes
Cap	538	488	511
Service Time	4.863	5.495	5.139
HCM Lane V/C Ratio	1.428	0.885	1.205
HCM Control Delay	214.3	35.2	101.6
HCM Lane LOS	F	E	F
HCM 95th-tile Q	34.7	7.6	18.6

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Future Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				184	1447	16	284	47	0	0	68	42
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				205	1702	20	422	60	0	0	362	224
Arrive On Green				0.56	0.56	0.56	0.35	0.35	0.00	0.00	0.35	0.35
Sat Flow, veh/h				366	3034	35	1018	169	0	0	1022	631
Grp Volume(v), veh/h				861	0	786	331	0	0	0	0	110
Grp Sat Flow(s),veh/h/ln				1712	0	1723	1187	0	0	0	0	1653
Q Serve(g_s), s				48.9	0.0	40.5	24.4	0.0	0.0	0.0	0.0	5.1
Cycle Q Clear(g_c), s				48.9	0.0	40.5	29.4	0.0	0.0	0.0	0.0	5.1
Prop In Lane				0.21		0.02	0.86		0.00	0.00		0.38
Lane Grp Cap(c), veh/h				960	0	967	482	0	0	0	0	586
V/C Ratio(X)				0.90	0.00	0.81	0.69	0.00	0.00	0.00	0.00	0.19
Avail Cap(c_a), veh/h				980	0	987	482	0	0	0	0	586
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.79	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.3	0.0	19.5	34.7	0.0	0.0	0.0	0.0	24.5
Incr Delay (d2), s/veh				12.8	0.0	7.5	6.2	0.0	0.0	0.0	0.0	0.1
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				22.0	0.0	17.5	8.9	0.0	0.0	0.0	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				34.1	0.0	26.9	40.9	0.0	0.0	0.0	0.0	24.7
LnGrp LOS				C	A	C	D	A	A	A	A	C
Approach Vol, veh/h					1647			331			110	
Approach Delay, s/veh					30.7			40.9			24.7	
Approach LOS					C			D			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				43.0		65.7		43.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				39.0		63.0		39.0				
Max Q Clear Time (g_c+I1), s				7.1		50.9		31.4				
Green Ext Time (p_c), s				0.3		10.8		0.9				
Intersection Summary												
HCM 6th Ctrl Delay			32.0									
HCM 6th LOS			C									

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Future Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1616	0				0	253	258	42	221	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	2082					0	403	334	52	498	0
Arrive On Green	0.63	0.63	0.00				0.00	0.23	0.23	0.01	0.10	0.00
Sat Flow, veh/h	153	3294	1502				0	1772	1470	1647	1730	0
Grp Volume(v), veh/h	908	787	0				0	253	258	42	221	0
Grp Sat Flow(s),veh/h/ln	1764	1683	1502				0	1772	1470	1647	1730	0
Q Serve(g_s), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Cycle Q Clear(g_c), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Prop In Lane	0.09		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1115	1064					0	403	334	52	498	0
V/C Ratio(X)	0.81	0.74					0.00	0.63	0.77	0.81	0.44	0.00
Avail Cap(c_a), veh/h	1115	1064					0	403	334	75	535	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.97	0.97	0.99	0.99	0.00
Uniform Delay (d), s/veh	15.3	14.0	0.0				0.0	38.3	39.8	54.1	41.5	0.0
Incr Delay (d2), s/veh	6.6	4.6	0.0				0.0	7.0	15.4	26.3	0.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	18.1	14.0	0.0				0.0	6.8	7.8	1.6	6.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.9	18.6	0.0				0.0	45.3	55.2	80.4	41.8	0.0
LnGrp LOS	C	B					A	D	E	F	D	A
Approach Vol, veh/h		1695	A					511			263	
Approach Delay, s/veh		20.4						50.3			48.0	
Approach LOS		C						D			D	

Timer - Assigned Phs	2	4	7	8
Phs Duration (G+Y+Rc), s	73.5	36.5	7.5	29.0
Change Period (Y+Rc), s	4.0	* 4.8	4.0	4.8
Max Green Setting (Gmax), s	68.0	* 34	5.0	24.2
Max Q Clear Time (g_c+I1), s	44.9	15.3	4.8	20.1
Green Ext Time (p_c), s	19.7	0.5	0.0	0.7

Intersection Summary	
HCM 6th Ctrl Delay	29.5
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Future Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	179	1526	132	11	1242	26	105	26	11	184	21	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	343	2075	925	24	1398	623	272	64	23	258	24	142
Arrive On Green	0.20	0.62	0.62	0.01	0.43	0.43	0.25	0.26	0.24	0.25	0.26	0.24
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	842	250	92	812	96	558
Grp Volume(v), veh/h	179	1526	132	11	1242	26	142	0	0	331	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1185	0	0	1465	0	0
Q Serve(g_s), s	10.4	35.0	4.1	0.7	39.0	1.1	0.0	0.0	0.0	12.7	0.0	0.0
Cycle Q Clear(g_c), s	10.4	35.0	4.1	0.7	39.0	1.1	11.3	0.0	0.0	24.0	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.74		0.08	0.56		0.38
Lane Grp Cap(c), veh/h	343	2075	925	24	1398	623	354	0	0	418	0	0
V/C Ratio(X)	0.52	0.74	0.14	0.45	0.89	0.04	0.40	0.00	0.00	0.79	0.00	0.00
Avail Cap(c_a), veh/h	343	2075	925	66	1446	645	413	0	0	481	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	39.0	14.8	8.9	53.7	28.8	18.1	34.8	0.0	0.0	39.8	0.0	0.0
Incr Delay (d2), s/veh	1.0	2.4	0.3	7.9	8.8	0.1	0.5	0.0	0.0	7.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	13.4	1.4	0.3	15.8	0.4	3.3	0.0	0.0	9.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	40.0	17.2	9.2	61.7	37.5	18.2	35.3	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	D	B	A	E	D	B	D	A	A	D	A	A
Approach Vol, veh/h		1837			1279			142			331	
Approach Delay, s/veh		18.8			37.4			35.3			47.1	
Approach LOS		B			D			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.6	72.3		32.1	26.4	51.5		32.1
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5
Max Green Setting (Gmax), s	4.0	* 61		31.3	15.5	49.2		31.3
Max Q Clear Time (g_c+I1), s	2.7	37.0		26.0	12.4	41.0		13.3
Green Ext Time (p_c), s	0.0	19.6		0.5	0.1	6.6		0.4

Intersection Summary	
HCM 6th Ctrl Delay	28.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	3.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1535	90	30	1230	25	70
Future Vol, veh/h	1535	90	30	1230	25	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1616	95	32	1295	26	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1711	0	2328	808
Stage 1	-	-	-	-	1616	-
Stage 2	-	-	-	-	712	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	350	-	32	328
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	453	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	350	-	29	328
Mov Cap-2 Maneuver	-	-	-	-	29	-
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	412	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	102.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	29	328	-	-	350	-
HCM Lane V/C Ratio	0.907	0.225	-	-	0.09	-
HCM Control Delay (s)	$ 334.4	19.1	-	-	16.3	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3	0.8	-	-	0.3	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Future Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1723	1723	1716	1716	1723	1723	1723	1800	1723	1800
Adj Flow Rate, veh/h	179	1511	0	105	1200	0	5	5	105	5	0	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	547	2609	1141	436	2509	0	74	0	3	74	0	3
Arrive On Green	0.07	0.78	0.00	0.06	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1460	1641	3346	0	75	75	1569	66	0	1654
Grp Volume(v), veh/h	179	1511	0	105	1200	0	115	0	0	131	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1460	1641	1630	0	1719	0	0	1719	0	0
Q Serve(g_s), s	1.2	9.2	0.0	0.7	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.2	9.2	0.0	0.7	6.8	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.04		0.96
Lane Grp Cap(c), veh/h	547	2609	1141	436	2509	0	77	0	0	77	0	0
V/C Ratio(X)	0.33	0.58	0.00	0.24	0.48	0.00	1.48	0.00	0.00	1.70	0.00	0.00
Avail Cap(c_a), veh/h	888	4942	2160	660	4566	0	855	0	0	851	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	1.8	2.2	0.0	2.2	2.1	0.0	25.4	0.0	0.0	25.4	0.0	0.0
Incr Delay (d2), s/veh	0.3	0.4	0.0	0.2	0.3	0.0	228.6	0.0	0.0	323.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.2	0.0	0.0	0.1	0.0	5.8	0.0	0.0	7.8	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	2.1	2.7	0.0	2.4	2.4	0.0	254.0	0.0	0.0	348.6	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1690			1305			115			131	
Approach Delay, s/veh		2.6			2.4			254.0			348.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	43.0		0.0	7.1	43.6		0.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.0				
Max Green Setting (Gmax), s	14.0	69.0		23.0	10.0	73.0		23.0				
Max Q Clear Time (g_c+I1), s	3.2	8.8		0.0	2.7	11.2		0.0				
Green Ext Time (p_c), s	0.3	17.7		0.0	0.1	26.4		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			25.4									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	0.4					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	1535	1235	25	10	0
Future Vol, veh/h	5	1535	1235	25	10	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	1616	1300	26	11	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1326	0	-	0	2131	663
Stage 1	-	-	-	-	1313	-
Stage 2	-	-	-	-	818	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	517	-	-	-	42	404
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	394	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	517	-	-	-	42	404
Mov Cap-2 Maneuver	-	-	-	-	42	-
Stage 1	-	-	-	-	214	-
Stage 2	-	-	-	-	394	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	117.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	517	-	-	-	42
HCM Lane V/C Ratio	0.01	-	-	-	0.251
HCM Control Delay (s)	12	-	-	-	117.3
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	0.8

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Future Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	32	200	95	168	74	32	116	242	137	53	563	42
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	429	238	113	317	327	141	294	748	631	494	704	594
Arrive On Green	0.03	0.21	0.21	0.10	0.28	0.28	0.06	0.42	0.42	0.04	0.40	0.40
Sat Flow, veh/h	1714	1152	547	1688	1173	507	1688	1772	1495	1674	1758	1482
Grp Volume(v), veh/h	32	0	295	168	0	106	116	242	137	53	563	42
Grp Sat Flow(s),veh/h/ln	1714	0	1700	1688	0	1680	1688	1772	1495	1674	1758	1482
Q Serve(g_s), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Cycle Q Clear(g_c), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Prop In Lane	1.00		0.32	1.00		0.30	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	429	0	351	317	0	468	294	748	631	494	704	594
V/C Ratio(X)	0.07	0.00	0.84	0.53	0.00	0.23	0.39	0.32	0.22	0.11	0.80	0.07
Avail Cap(c_a), veh/h	484	0	524	348	0	617	294	1067	900	530	1058	893
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	25.9	18.3	0.0	18.9	14.3	13.2	12.5	11.8	18.0	12.6
Incr Delay (d2), s/veh	0.1	0.0	6.6	1.0	0.0	0.2	0.6	0.5	0.4	0.1	4.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	5.0	1.9	0.0	1.2	0.9	2.2	1.3	0.4	7.6	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	32.5	19.3	0.0	19.1	14.9	13.7	12.9	11.8	22.8	12.7
LnGrp LOS	C	A	C	B	A	B	B	B	B	B	C	B
Approach Vol, veh/h		327			274			495			658	
Approach Delay, s/veh		31.4			19.2			13.8			21.3	
Approach LOS		C			B			B			C	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	6.5	32.8	10.8	18.1	8.0	31.3	5.8	23.0				
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0				
Max Green Setting (Gmax), s	4.0	40.2	8.0	21.0	4.0	40.2	4.0	25.0				
Max Q Clear Time (g_c+I1), s	3.3	8.2	7.0	13.3	4.8	21.2	3.0	5.3				
Green Ext Time (p_c), s	0.0	3.5	0.0	0.6	0.0	5.3	0.0	0.2				
Intersection Summary												
HCM 6th Ctrl Delay			20.7									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	31					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	400	120	230	570	105	80
Future Vol, veh/h	400	120	230	570	105	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	421	126	242	600	111	84

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	547	0	1568	484
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	1084	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1027	-	123	585
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1027	-	~ 94	585
Mov Cap-2 Maneuver	-	-	-	-	~ 94	-
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	249	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.8	239.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	148	-	-	1027	-
HCM Lane V/C Ratio	1.316	-	-	0.236	-
HCM Control Delay (s)	239.8	-	-	9.6	-
HCM Lane LOS	F	-	-	A	-
HCM 95th %tile Q(veh)	12	-	-	0.9	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Future Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	263	2321	16	11	1511	0	74	53	11	174	11	95
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	182	1735	774	73	1496		65	46	10	207	13	113
Arrive On Green	0.11	0.52	0.52	0.04	0.45	0.00	0.08	0.08	0.08	0.21	0.21	0.21
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	826	591	123	1008	64	550
Grp Volume(v), veh/h	263	2321	16	11	1511	0	138	0	0	280	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1622	0	0
Q Serve(g_s), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Cycle Q Clear(g_c), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.54		0.08	0.62		0.34
Lane Grp Cap(c), veh/h	182	1735	774	73	1496		121	0	0	333	0	0
V/C Ratio(X)	1.44	1.34	0.02	0.15	1.01		1.14	0.00	0.00	0.84	0.00	0.00
Avail Cap(c_a), veh/h	182	1735	774	73	1496		121	0	0	541	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.4	24.7	12.1	46.9	27.9	0.0	46.8	0.0	0.0	38.9	0.0	0.0
Incr Delay (d2), s/veh	227.8	156.2	0.0	0.6	25.8	0.0	124.9	0.0	0.0	6.4	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.9	55.0	0.2	0.3	21.0	0.0	7.3	0.0	0.0	7.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	273.3	180.9	12.1	47.4	53.8	0.0	171.7	0.0	0.0	45.3	0.0	0.0
LnGrp LOS	F	F	B	D	F		F	A	A	D	A	A
Approach Vol, veh/h		2600			1522	A		138			280	
Approach Delay, s/veh		189.2			53.7			171.7			45.3	
Approach LOS		F			D			F			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.0	50.0		24.9	8.5	56.5		12.0				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	10.5	43.0		33.0	4.0	49.5		7.5				
Max Q Clear Time (g_c+I1), s	13.0	48.0		18.9	2.6	54.5		10.0				
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			134.3									
HCM 6th LOS			F									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Future Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
Arrive On Green	0.07	0.43	0.43	0.29	1.00	1.00	0.23	0.22	0.22	0.06	0.06	0.06
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1511	1688	1772	1502
Grp Volume(v), veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1511	1688	1772	1502
Q Serve(g_s), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Cycle Q Clear(g_c), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
V/C Ratio(X)	0.81	0.98	0.47	0.51	0.86	0.31	0.26	0.70	0.94	0.51	1.45	0.74
Avail Cap(c_a), veh/h	261	1450	1003	463	1725	851	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.51	0.51	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.1	36.5	10.5	42.5	0.0	0.0	41.4	46.5	49.7	59.1	61.0	60.0
Incr Delay (d2), s/veh	16.5	20.0	1.6	0.3	3.2	0.5	0.1	4.5	33.1	2.9	223.6	8.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	24.5	11.9	2.8	0.8	0.1	2.6	8.6	13.1	1.8	10.3	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.5	56.5	12.1	42.8	3.2	0.5	41.5	51.1	82.9	62.0	284.6	68.2
LnGrp LOS	D	E	B	D	A	A	D	D	F	E	F	E
Approach Vol, veh/h		2111			1989			785			279	
Approach Delay, s/veh		45.5			7.6			61.5			189.6	
Approach LOS		D			A			E			F	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	24.7	60.0	12.0	13.0	71.7	33.4
Change Period (Y+Rc), s	6.0	* 6	4.0	4.0	6.0	4.5
Max Green Setting (Gmax), s	10.0	* 54	18.0	9.0	55.0	29.5
Max Q Clear Time (g_c+I1), s	11.0	56.4	7.8	11.0	2.0	28.7
Green Ext Time (p_c), s	0.0	0.0	0.2	0.0	51.5	0.1

Intersection Summary	
HCM 6th Ctrl Delay	41.1
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Future Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3315		1644	3358	1471	1693	1569		3317	1580	
Flt Permitted	0.08	1.00		0.06	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	140	3315		102	3358	1471	1693	1569		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1679	10	41	1628	51	173	26	102	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	20	0	91	0	0	71	0
Lane Group Flow (vph)	51	1689	0	41	1628	31	173	37	0	224	113	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	82.0	78.8		82.0	78.8	78.8	13.5	13.5		17.1	17.1	
Effective Green, g (s)	83.0	80.2		82.0	80.2	80.2	14.5	13.5		17.1	17.1	
Actuated g/C Ratio	0.64	0.62		0.63	0.62	0.62	0.11	0.10		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	133	2045		102	2071	907	188	162		436	207	
v/s Ratio Prot	c0.01	c0.51		0.01	0.48		c0.10	0.02		0.07	c0.07	
v/s Ratio Perm	0.23			0.24		0.02						
v/c Ratio	0.38	0.83		0.40	0.79	0.03	0.92	0.23		0.51	0.54	
Uniform Delay, d1	35.2	19.4		40.6	18.5	9.7	57.2	53.5		52.6	52.8	
Progression Factor	0.38	0.21		0.47	0.46	0.50	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.4		1.0	2.1	0.0	43.5	0.7		0.6	2.0	
Delay (s)	14.1	6.4		20.1	10.6	4.9	100.7	54.2		53.2	54.8	
Level of Service	B	A		C	B	A	F	D		D	D	
Approach Delay (s)		6.6			10.7			80.9			53.9	
Approach LOS		A			B			F			D	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Future Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	126	1641	0	56	1465	96	116	81	35	212	56	167
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	420	2226		232	1638	713	184	118	51	256	30	90
Arrive On Green	0.41	1.00	0.00	0.03	0.48	0.48	0.11	0.10	0.10	0.08	0.08	0.08
Sat Flow, veh/h	1688	3331	1502	1661	3383	1473	1674	1160	501	3326	393	1173
Grp Volume(v), veh/h	126	1641	0	56	1465	96	116	0	116	212	0	223
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1473	1674	0	1661	1663	0	1567
Q Serve(g_s), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.75
Lane Grp Cap(c), veh/h	420	2226		232	1638	713	184	0	169	256	0	121
V/C Ratio(X)	0.30	0.74		0.24	0.89	0.13	0.63	0.00	0.69	0.83	0.00	1.85
Avail Cap(c_a), veh/h	420	2226		234	1639	714	476	0	460	256	0	121
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.53	0.53	0.00	0.46	0.46	0.46	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	0.0	0.0	19.8	30.5	18.5	55.4	0.0	56.4	59.2	0.0	60.0
Incr Delay (d2), s/veh	0.1	1.2	0.0	0.1	4.0	0.2	2.2	0.0	3.0	19.2	0.0	412.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.4	0.0	0.9	20.7	1.6	3.8	0.0	3.9	4.2	0.0	17.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.2	1.2	0.0	19.9	34.5	18.7	57.6	0.0	59.3	78.3	0.0	472.7
LnGrp LOS	C	A		B	C	B	E	A	E	E	A	F
Approach Vol, veh/h		1767	A		1617			232			435	
Approach Delay, s/veh		3.3			33.0			58.5			280.5	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.9	90.9		14.0	31.8	66.9		17.3
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0
Max Green Setting (Gmax), s	4.0	* 63		10.0	* 5	* 62		36.0
Max Q Clear Time (g_c+I1), s	4.5	2.0		12.0	2.0	53.2		10.8
Green Ext Time (p_c), s	0.0	59.0		0.0	0.1	8.3		0.8

Intersection Summary	
HCM 6th Ctrl Delay	48.1
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Future Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	82	1673	184	71	1398	301	92	5	26	270	148	87
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	127	1408	626	375	1675	834	115	30	155	216	191	112
Arrive On Green	0.04	0.42	0.42	0.19	0.57	0.57	0.07	0.12	0.13	0.13	0.18	0.19
Sat Flow, veh/h	1688	3367	1498	1647	2941	1465	1701	245	1275	1701	1053	619
Grp Volume(v), veh/h	82	1673	184	71	1398	301	92	0	31	270	0	235
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1465	1701	0	1520	1701	0	1672
Q Serve(g_s), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Cycle Q Clear(g_c), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.84	1.00		0.37
Lane Grp Cap(c), veh/h	127	1408	626	375	1675	834	115	0	185	216	0	303
V/C Ratio(X)	0.65	1.19	0.29	0.19	0.83	0.36	0.80	0.00	0.17	1.25	0.00	0.78
Avail Cap(c_a), veh/h	127	1408	626	375	1675	834	186	0	414	216	0	486
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.55	0.55	0.55	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.3	32.0	11.4	36.3	19.4	12.8	50.6	0.0	43.1	48.0	0.0	42.8
Incr Delay (d2), s/veh	5.3	89.0	0.7	0.1	5.1	1.2	7.7	0.0	0.3	143.7	0.0	2.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	34.9	2.3	1.6	15.2	4.2	2.8	0.0	0.8	14.6	0.0	6.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	33.6	121.0	12.1	36.4	24.5	14.0	58.2	0.0	43.4	191.7	0.0	45.4
LnGrp LOS	C	F	B	D	C	B	E	A	D	F	A	D
Approach Vol, veh/h		1939			1770			123			505	
Approach Delay, s/veh		106.9			23.2			54.5			123.7	
Approach LOS		F			C			D			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.6	50.0	11.4	23.9	8.0	66.6	18.0	17.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	45.2	12.0	31.5	4.0	46.0	14.0	29.5
Max Q Clear Time (g_c+I1), s	2.0	48.0	7.9	16.7	5.4	44.9	16.0	4.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	1.1	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	73.2
HCM 6th LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	60	15	395	380	5
Future Vol, veh/h	5	60	15	395	380	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	63	16	416	400	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	854	406	407	0	-	0
Stage 1	405	-	-	-	-	-
Stage 2	449	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	326	641	1157	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	320	639	1155	-	-	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	658	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1155	-	320	639	-	-
HCM Lane V/C Ratio	0.014	-	0.016	0.099	-	-
HCM Control Delay (s)	8.2	0	16.4	11.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.3	-	-

Intersection	
Int Delay, s/veh	17

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	185	85	505	245	15	670
Future Vol, veh/h	185	85	505	245	15	670
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	195	89	532	258	16	705

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1046	663	0	0	790	0
Stage 1	661	-	-	-	-	-
Stage 2	385	-	-	-	-	-
Critical Hdwy	6.66	6.26	-	-	4.145	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.86	-	-	-	-	-
Follow-up Hdwy	3.538	3.338	-	-	2.2285	-
Pot Cap-1 Maneuver	235	456	-	-	822	-
Stage 1	508	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	231	455	-	-	822	-
Mov Cap-2 Maneuver	231	-	-	-	-	-
Stage 1	508	-	-	-	-	-
Stage 2	641	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	106.6	0	0.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	273	822	-
HCM Lane V/C Ratio	-	-	1.041	0.019	-
HCM Control Delay (s)	-	-	106.6	9.5	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	11	0.1	-

Intersection	
Intersection Delay, s/veh	221.9
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	255	65	650	850	5
Future Vol, veh/h	100	255	65	650	850	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	105	268	68	684	895	5
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	18.1	203.4	322
HCM LOS	C	F	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	9%	100%	0%	0%	0%
Vol Thru, %	91%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	715	100	255	850	5
LT Vol	65	100	0	0	0
Through Vol	650	0	0	850	0
RT Vol	0	0	255	0	5
Lane Flow Rate	753	105	268	895	5
Geometry Grp	4	7	7	7	7
Degree of Util (X)	1.376	0.237	0.514	1.66	0.009
Departure Headway (Hd)	7.422	9.469	8.203	7.144	6.423
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	497	382	443	519	561
Service Time	5.422	7.169	5.903	4.844	4.123
HCM Lane V/C Ratio	1.515	0.275	0.605	1.724	0.009
HCM Control Delay	203.4	15.1	19.3	323.8	9.2
HCM Lane LOS	F	C	C	F	A
HCM 95th-tile Q	30.9	0.9	2.9	48.1	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Future Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				58	1463	16	263	53	0	0	105	26
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				68	1811	21	441	612	0	0	473	117
Arrive On Green				0.55	0.55	0.55	0.58	0.58	0.00	0.00	0.35	0.35
Sat Flow, veh/h				124	3284	38	1289	1772	0	0	1369	339
Grp Volume(v), veh/h				805	0	732	263	53	0	0	0	131
Grp Sat Flow(s),veh/h/ln				1724	0	1723	1289	1772	0	0	0	1708
Q Serve(g_s), s				43.2	0.0	36.5	17.5	1.5	0.0	0.0	0.0	6.0
Cycle Q Clear(g_c), s				43.2	0.0	36.5	23.5	1.5	0.0	0.0	0.0	6.0
Prop In Lane				0.07		0.02	1.00		0.00	0.00		0.20
Lane Grp Cap(c), veh/h				950	0	950	441	612	0	0	0	590
V/C Ratio(X)				0.85	0.00	0.77	0.60	0.09	0.00	0.00	0.00	0.22
Avail Cap(c_a), veh/h				1003	0	1002	441	612	0	0	0	590
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.87	0.87	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				20.8	0.0	19.3	22.5	15.5	0.0	0.0	0.0	25.5
Incr Delay (d2), s/veh				9.2	0.0	6.0	5.1	0.2	0.0	0.0	0.0	0.1
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				19.1	0.0	15.7	5.1	0.6	0.0	0.0	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				30.0	0.0	25.3	27.6	15.8	0.0	0.0	0.0	25.7
LnGrp LOS				C	A	C	C	B	A	A	A	C
Approach Vol, veh/h					1537			316			131	
Approach Delay, s/veh					27.7			25.7			25.7	
Approach LOS					C			C			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				42.0		64.7		42.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				38.0		64.0		38.0				
Max Q Clear Time (g_c+I1), s				8.0		45.2		25.5				
Green Ext Time (p_c), s				0.4		15.4		1.1				
Intersection Summary												
HCM 6th Ctrl Delay			27.3									
HCM 6th LOS			C									

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Future Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	84	1389	0				0	237	311	89	74	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	107	1853					0	451	375	111	620	0
Arrive On Green	0.57	0.57	0.00				0.00	0.25	0.25	0.02	0.12	0.00
Sat Flow, veh/h	188	3258	1502				0	1772	1473	1647	1730	0
Grp Volume(v), veh/h	789	684	0				0	237	311	89	74	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1473	1647	1730	0
Q Serve(g_s), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Cycle Q Clear(g_c), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Prop In Lane	0.11		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1002	957					0	451	375	111	620	0
V/C Ratio(X)	0.79	0.71					0.00	0.53	0.83	0.80	0.12	0.00
Avail Cap(c_a), veh/h	1002	957					0	451	375	165	676	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.93	0.93	0.98	0.98	0.00
Uniform Delay (d), s/veh	18.5	17.2	0.0				0.0	35.3	38.7	53.0	33.0	0.0
Incr Delay (d2), s/veh	6.2	4.6	0.0				0.0	4.0	17.6	11.3	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.7	13.3	0.0				0.0	5.8	9.5	2.9	1.8	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.7	21.8	0.0				0.0	39.3	56.4	64.3	33.0	0.0
LnGrp LOS	C	C					A	D	E	E	C	A
Approach Vol, veh/h		1473	A					548			163	
Approach Delay, s/veh		23.4						49.0			50.1	
Approach LOS		C						D			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		66.6		43.4			11.4	32.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		59.0		43.0			11.0	27.2				
Max Q Clear Time (g_c+I1), s		40.4		6.2			7.9	23.9				
Green Ext Time (p_c), s		14.8		0.2			0.0	0.7				

Intersection Summary		
HCM 6th Ctrl Delay		31.8
HCM 6th LOS		C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Future Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	163	1437	137	11	1237	21	95	26	11	142	21	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	366	1887	841	192	1494	666	193	254	108	331	38	283
Arrive On Green	0.22	0.56	0.56	0.12	0.46	0.46	0.21	0.21	0.20	0.21	0.21	0.20
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	163	1437	137	11	1237	21	95	0	37	142	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.2	36.0	4.9	0.7	36.7	0.9	8.1	0.0	1.9	10.1	0.0	11.7
Cycle Q Clear(g_c), s	9.2	36.0	4.9	0.7	36.7	0.9	19.8	0.0	1.9	12.0	0.0	11.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	366	1887	841	192	1494	666	193	0	362	331	0	321
V/C Ratio(X)	0.44	0.76	0.16	0.06	0.83	0.03	0.49	0.00	0.10	0.43	0.00	0.56
Avail Cap(c_a), veh/h	366	2121	945	192	1640	732	203	0	376	342	0	334
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.3	18.5	11.7	43.0	25.8	16.1	48.1	0.0	35.1	40.2	0.0	39.4
Incr Delay (d2), s/veh	0.5	3.0	0.4	0.1	5.4	0.1	1.5	0.0	0.1	0.7	0.0	1.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	14.3	1.7	0.3	14.3	0.3	2.6	0.0	0.8	3.5	0.0	4.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.8	21.5	12.1	43.1	31.2	16.2	49.5	0.0	35.2	40.9	0.0	40.9
LnGrp LOS	D	C	B	D	C	B	D	A	D	D	A	D
Approach Vol, veh/h		1737			1269			132			321	
Approach Delay, s/veh		22.3			31.0			45.5			40.9	
Approach LOS		C			C			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	17.1	65.7		27.3	27.9	54.8		27.3
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5
Max Green Setting (Gmax), s	4.0	69.3		22.7	17.5	55.8		22.7
Max Q Clear Time (g_c+I1), s	2.7	38.0		14.0	11.2	38.7		21.8
Green Ext Time (p_c), s	0.0	23.7		0.7	0.2	12.2		0.0

Intersection Summary	
HCM 6th Ctrl Delay	28.1
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	5.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1390	100	110	1220	25	85
Future Vol, veh/h	1390	100	110	1220	25	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1463	105	116	1284	26	89

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1568	0	2337	732
Stage 1	-	-	-	-	1463	-
Stage 2	-	-	-	-	874	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	398	-	32	368
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	373	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	398	-	~ 23	368
Mov Cap-2 Maneuver	-	-	-	-	~ 23	-
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	264	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	122.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	23	368	-	-	398	-
HCM Lane V/C Ratio	1.144	0.243	-	-	0.291	-
HCM Control Delay (s)	$ 479.7	17.9	-	-	17.7	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3.4	0.9	-	-	1.2	-

Notes
~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Future Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	137	1421	5	106	1305	0	5	5	105	5	0	105
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	177	2488	1119	136	2347	0	82	0	4	82	0	4
Arrive On Green	0.11	0.75	0.75	0.08	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3346	0	77	77	1614	78	0	1641
Grp Volume(v), veh/h	137	1421	5	106	1305	0	115	0	0	110	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	0	1768	0	0	1719	0	0
Q Serve(g_s), s	3.7	8.7	0.0	2.8	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.7	8.7	0.0	2.8	8.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.05		0.95
Lane Grp Cap(c), veh/h	177	2488	1119	136	2347	0	86	0	0	86	0	0
V/C Ratio(X)	0.77	0.57	0.00	0.78	0.56	0.00	1.34	0.00	0.00	1.28	0.00	0.00
Avail Cap(c_a), veh/h	656	5089	2288	551	4754	0	969	0	0	938	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	20.0	2.6	1.5	20.7	3.0	0.0	23.0	0.0	0.0	23.0	0.0	0.0
Incr Delay (d2), s/veh	5.3	0.4	0.0	6.9	0.4	0.0	166.7	0.0	0.0	141.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.2	0.0	1.1	0.1	0.0	4.8	0.0	0.0	4.2	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.3	3.0	1.5	27.6	3.4	0.0	189.7	0.0	0.0	164.6	0.0	0.0
LnGrp LOS	C	A	A	C	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1563			1411			115			110	
Approach Delay, s/veh		5.0			5.3			189.7			164.6	
Approach LOS		A			A			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.9	37.1		0.0	7.7	38.2		0.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	18.0	67.0		23.0	15.0	70.0		23.0
Max Q Clear Time (g_c+I1), s	5.7	10.6		0.0	4.8	10.7		0.0
Green Ext Time (p_c), s	0.2	20.0		0.0	0.2	23.6		0.0

Intersection Summary		
HCM 6th Ctrl Delay		17.2
HCM 6th LOS		B

Intersection	
Int Delay, s/veh	21.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Future Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	1526	5	105	1405	26	5	5	105	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1431	0	0	1531	0	0	2449	3177	763	2404	-	-
Stage 1	-	-	-	-	-	-	1536	1536	-	1628	-	-
Stage 2	-	-	-	-	-	-	913	1641	-	776	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	471	-	-	431	-	-	16	10	347	17	0	0
Stage 1	-	-	-	-	-	-	121	176	-	106	0	0
Stage 2	-	-	-	-	-	-	294	156	-	356	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	471	-	-	431	-	-	13	7	347	~ 4	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	7	-	~ 4	-	-
Stage 1	-	-	-	-	-	-	120	174	-	105	-	-
Stage 2	-	-	-	-	-	-	222	118	-	238	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	1.1	$ 357.9	$ 2367.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	79	471	-	-	431	-	-	4
HCM Lane V/C Ratio	1.466	0.011	-	-	0.244	-	-	2.632
HCM Control Delay (s)	$ 357.9	12.7	-	-	16	-	$ 2367.8	
HCM Lane LOS	F	B	-	-	C	-	-	F
HCM 95th %tile Q(veh)	9.3	0	-	-	0.9	-	-	2.4

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Future Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	42	32	142	253	111	32	32	316	437	11	495	16
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	378	43	193	436	355	102	302	728	614	337	693	584
Arrive On Green	0.03	0.15	0.15	0.15	0.27	0.27	0.03	0.41	0.41	0.01	0.39	0.39
Sat Flow, veh/h	1714	288	1277	1688	1322	381	1688	1772	1494	1674	1758	1482
Grp Volume(v), veh/h	42	0	174	253	0	143	32	316	437	11	495	16
Grp Sat Flow(s),veh/h/ln	1714	0	1565	1688	0	1703	1688	1772	1494	1674	1758	1482
Q Serve(g_s), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Cycle Q Clear(g_c), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Prop In Lane	1.00		0.82	1.00		0.22	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	378	0	236	436	0	458	302	728	614	337	693	584
V/C Ratio(X)	0.11	0.00	0.74	0.58	0.00	0.31	0.11	0.43	0.71	0.03	0.71	0.03
Avail Cap(c_a), veh/h	438	0	565	499	0	820	371	1158	977	434	1149	969
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.8	0.0	23.6	15.7	0.0	17.0	12.1	12.3	14.3	11.2	14.8	10.8
Incr Delay (d2), s/veh	0.1	0.0	3.3	1.0	0.0	0.3	0.1	0.9	3.3	0.0	2.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	2.3	2.4	0.0	1.4	0.2	2.5	4.6	0.1	5.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.9	0.0	26.9	16.7	0.0	17.3	12.2	13.1	17.5	11.2	17.8	10.8
LnGrp LOS	B	A	C	B	A	B	B	B	B	B	B	B
Approach Vol, veh/h		216			396			785			522	
Approach Delay, s/veh		25.5			16.9			15.5			17.4	
Approach LOS		C			B			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	4.7	27.9	12.8	12.8	5.6	26.9	6.0	19.6
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	37.2	11.0	21.0	4.0	37.2	4.0	28.0
Max Q Clear Time (g_c+I1), s	2.2	16.2	8.8	8.2	2.7	15.8	3.2	5.9
Green Ext Time (p_c), s	0.0	6.9	0.2	0.4	0.0	4.5	0.0	0.4

Intersection Summary	
HCM 6th Ctrl Delay	17.5
HCM 6th LOS	B

Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	60	210	615	0	15
Future Vol, veh/h	740	60	210	615	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	779	63	221	647	0	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	842	0	-	811
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.11	-	-	6.21
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.209	-	-	3.309
Pot Cap-1 Maneuver	-	-	798	-	0	381
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	798	-	-	381
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	14.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	381	-	-	798	-
HCM Lane V/C Ratio	0.041	-	-	0.277	-
HCM Control Delay (s)	14.9	-	-	11.2	-
HCM Lane LOS	B	-	-	B	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	-

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Future Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	105	1605	5	5	784	0	26	42	11	258	21	32
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	145	1750	780	73	1583		32	52	14	303	25	38
Arrive On Green	0.09	0.52	0.52	0.04	0.48	0.00	0.07	0.06	0.07	0.22	0.22	0.22
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	507	818	214	1387	113	172
Grp Volume(v), veh/h	105	1605	5	5	784	0	79	0	0	311	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1672	0	0
Q Serve(g_s), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Cycle Q Clear(g_c), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.14	0.83		0.10
Lane Grp Cap(c), veh/h	145	1750	780	73	1583		97	0	0	365	0	0
V/C Ratio(X)	0.73	0.92	0.01	0.07	0.50		0.81	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	229	1765	787	73	1583		97	0	0	552	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.9	22.7	11.9	47.2	18.4	0.0	47.5	0.0	0.0	38.7	0.0	0.0
Incr Delay (d2), s/veh	4.2	8.4	0.0	0.2	0.5	0.0	36.8	0.0	0.0	8.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	17.0	0.1	0.1	5.7	0.0	3.0	0.0	0.0	8.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.1	31.1	11.9	47.5	18.9	0.0	84.3	0.0	0.0	46.7	0.0	0.0
LnGrp LOS	D	C	B	D	B		F	A	A	D	A	A
Approach Vol, veh/h		1715			789	A		79			311	
Approach Delay, s/veh		32.2			19.1			84.3			46.7	
Approach LOS		C			B			F			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.8	53.2		26.5	8.5	57.5		10.5				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	13.5	41.5		33.0	4.0	51.0		6.0				
Max Q Clear Time (g_c+I1), s	8.2	18.7		20.4	2.3	47.1		7.2				
Green Ext Time (p_c), s	0.1	7.3		1.1	0.0	3.5		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			31.6
HCM 6th LOS			C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Future Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
Arrive On Green	0.13	0.43	0.43	0.18	0.79	0.76	0.23	0.23	0.23	0.12	0.12	0.12
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Cycle Q Clear(g_c), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
V/C Ratio(X)	0.71	0.48	0.47	0.83	0.51	0.51	0.26	0.65	0.97	0.21	0.72	0.87
Avail Cap(c_a), veh/h	614	1461	1015	397	1306	750	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.83	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	26.4	10.0	52.1	9.3	7.7	40.9	45.6	49.8	51.6	55.0	56.2
Incr Delay (d2), s/veh	1.8	1.1	1.5	8.0	1.2	2.1	0.1	3.3	39.8	0.4	7.4	27.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	7.6	11.8	3.8	2.5	3.5	2.6	8.0	14.3	1.3	5.3	6.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	27.5	11.5	60.1	10.5	9.7	41.0	48.9	89.6	51.9	62.4	83.7
LnGrp LOS	C	C	B	E	B	A	D	D	F	D	E	F
Approach Vol, veh/h		1495			1299			790			353	
Approach Delay, s/veh		21.0			19.7			64.1			70.7	
Approach LOS		C			B			E			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.9	60.4		19.7	21.1	55.2		34.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.5				
Max Green Setting (Gmax), s	16.0	48.0		18.0	30.0	34.0		29.5				
Max Q Clear Time (g_c+I1), s	11.6	21.5		15.4	16.2	15.3		30.3				
Green Ext Time (p_c), s	0.3	15.5		0.2	0.9	15.8		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			33.7									
HCM 6th LOS			C									

Notes
User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Future Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.87		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3313		1644	3358	1471	1693	1555		3317	1580	
Flt Permitted	0.24	1.00		0.21	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	422	3313		361	3358	1471	1693	1555		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	985	10	56	939	51	194	26	148	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	22	0	126	0	0	98	0
Lane Group Flow (vph)	51	995	0	56	939	29	194	48	0	224	86	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	77.3	72.6		76.1	72.0	72.0	19.2	19.2		16.7	16.7	
Effective Green, g (s)	78.3	74.0		76.1	73.4	73.4	20.2	19.2		16.7	16.7	
Actuated g/C Ratio	0.60	0.57		0.59	0.56	0.56	0.16	0.15		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	304	1885		251	1895	830	263	229		426	202	
v/s Ratio Prot	0.01	c0.30		c0.01	0.28		c0.11	0.03		c0.07	0.05	
v/s Ratio Perm	0.09			0.12		0.02						
v/c Ratio	0.17	0.53		0.22	0.50	0.03	0.74	0.21		0.53	0.43	
Uniform Delay, d1	19.9	17.2		23.3	17.1	12.6	52.4	48.7		52.9	52.2	
Progression Factor	0.58	0.61		0.40	0.46	0.06	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.9		0.2	0.8	0.1	10.3	0.5		0.8	0.8	
Delay (s)	11.7	11.5		9.4	8.6	0.8	62.7	49.2		53.7	53.1	
Level of Service	B	B		A	A	A	E	D		D	D	
Approach Delay (s)		11.5			8.3			56.3			53.4	
Approach LOS		B			A			E			D	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
5: Ruben Lane & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Future Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	131	1116	0	86	783	106	91	71	25	222	51	152
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	634	2049		279	1248	543	163	111	39	409	49	145
Arrive On Green	0.57	1.00	0.00	0.05	0.37	0.37	0.10	0.09	0.09	0.12	0.12	0.12
Sat Flow, veh/h	1688	3331	1502	1661	3383	1472	1674	1237	436	3326	395	1179
Grp Volume(v), veh/h	131	1116	0	86	783	106	91	0	96	222	0	203
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1472	1674	0	1673	1663	0	1574
Q Serve(g_s), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.26	1.00		0.75
Lane Grp Cap(c), veh/h	634	2049		279	1248	543	163	0	150	409	0	194
V/C Ratio(X)	0.21	0.54		0.31	0.63	0.20	0.56	0.00	0.64	0.54	0.00	1.05
Avail Cap(c_a), veh/h	634	2049		300	1379	600	476	0	463	409	0	194
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.00	0.87	0.87	0.87	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.1	0.0	0.0	29.6	33.7	27.9	56.0	0.0	57.2	53.6	0.0	57.0
Incr Delay (d2), s/veh	0.1	0.9	0.0	0.3	2.1	0.7	1.8	0.0	2.8	1.1	0.0	77.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.3	0.0	1.9	10.3	2.3	3.0	0.0	3.2	3.5	0.0	10.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.2	0.9	0.0	30.0	35.8	28.6	57.8	0.0	59.9	54.6	0.0	134.8
LnGrp LOS	B	A		C	D	C	E	A	E	D	A	F
Approach Vol, veh/h		1247	A		975			187			425	
Approach Delay, s/veh		2.3			34.5			58.9			92.9	
Approach LOS		A			C			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	10.4	84.0		20.0	42.4	52.0		15.7				
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0				
Max Green Setting (Gmax), s	8.0	* 53		16.0	* 9	* 52		36.0				
Max Q Clear Time (g_c+I1), s	6.7	2.0		18.0	2.0	26.7		9.2				
Green Ext Time (p_c), s	0.0	43.3		0.0	0.2	19.8		0.6				

Intersection Summary		
HCM 6th Ctrl Delay		30.7
HCM 6th LOS		C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Future Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	77	1199	92	46	806	214	61	5	15	260	61	92
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	536	1282	570	425	1037	516	77	36	109	278	137	206
Arrive On Green	0.24	0.38	0.38	0.22	0.35	0.35	0.05	0.09	0.10	0.16	0.21	0.22
Sat Flow, veh/h	1688	3367	1498	1647	2941	1464	1701	384	1152	1701	641	967
Grp Volume(v), veh/h	77	1199	92	46	806	214	61	0	20	260	0	153
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1464	1701	0	1536	1701	0	1609
Q Serve(g_s), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Cycle Q Clear(g_c), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.75	1.00		0.60
Lane Grp Cap(c), veh/h	536	1282	570	425	1037	516	77	0	146	278	0	342
V/C Ratio(X)	0.14	0.94	0.16	0.11	0.78	0.41	0.79	0.00	0.14	0.93	0.00	0.45
Avail Cap(c_a), veh/h	536	1285	572	425	1123	559	139	0	419	278	0	570
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.79	0.79	0.79	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	27.0	32.7	13.9	33.8	31.7	10.9	52.0	0.0	45.5	45.4	0.0	37.5
Incr Delay (d2), s/veh	0.1	11.5	0.5	0.1	5.7	2.4	10.3	0.0	0.3	36.4	0.0	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	16.6	1.6	1.0	10.3	2.8	1.9	0.0	0.5	9.8	0.0	3.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	44.2	14.3	33.9	37.5	13.3	62.3	0.0	45.8	81.9	0.0	38.1
LnGrp LOS	C	D	B	C	D	B	E	A	D	F	A	D
Approach Vol, veh/h		1368			1066			81			413	
Approach Delay, s/veh		41.3			32.5			58.2			65.6	
Approach LOS		D			C			E			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	27.7	45.9	9.0	27.4	30.8	42.8	22.0	14.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	41.2	9.0	38.5	4.0	42.0	18.0	29.5
Max Q Clear Time (g_c+I1), s	2.0	39.7	5.9	11.1	2.0	28.9	18.6	3.3
Green Ext Time (p_c), s	0.0	1.4	0.0	0.6	0.0	9.9	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	42.0
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Future Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				295	742	16	416	53	0	0	37	5
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				357	956	21	734	870	0	0	750	101
Arrive On Green				0.39	0.39	0.39	0.82	0.82	0.00	0.00	0.49	0.49
Sat Flow, veh/h				910	2439	54	1398	1772	0	0	1527	206
Grp Volume(v), veh/h				546	0	507	416	53	0	0	0	42
Grp Sat Flow(s),veh/h/ln				1684	0	1719	1398	1772	0	0	0	1734
Q Serve(g_s), s				32.1	0.0	28.0	13.1	0.6	0.0	0.0	0.0	1.4
Cycle Q Clear(g_c), s				32.1	0.0	28.0	14.5	0.6	0.0	0.0	0.0	1.4
Prop In Lane				0.54		0.03	1.00		0.00	0.00		0.12
Lane Grp Cap(c), veh/h				660	0	674	734	870	0	0	0	851
V/C Ratio(X)				0.83	0.00	0.75	0.57	0.06	0.00	0.00	0.00	0.05
Avail Cap(c_a), veh/h				735	0	750	734	870	0	0	0	851
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.86	0.86	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				30.1	0.0	28.8	6.6	5.1	0.0	0.0	0.0	14.6
Incr Delay (d2), s/veh				11.4	0.0	7.6	2.7	0.1	0.0	0.0	0.0	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				14.9	0.0	12.9	2.7	0.3	0.0	0.0	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				41.5	0.0	36.4	9.4	5.2	0.0	0.0	0.0	14.6
LnGrp LOS				D	A	D	A	A	A	A	A	B
Approach Vol, veh/h					1053			469			42	
Approach Delay, s/veh					39.0			8.9			14.6	
Approach LOS					D			A			B	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				58.0		47.1		58.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				54.0		48.0		54.0				
Max Q Clear Time (g_c+I1), s				3.4		34.1		16.5				
Green Ext Time (p_c), s				0.1		9.0		2.2				

Intersection Summary			
HCM 6th Ctrl Delay			29.3
HCM 6th LOS			C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Future Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	89	895	0				0	379	284	16	316	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	153	1613					0	644	539	23	716	0
Arrive On Green	0.51	0.51	0.00				0.00	0.36	0.36	0.00	0.14	0.00
Sat Flow, veh/h	297	3143	1502				0	1772	1482	1647	1730	0
Grp Volume(v), veh/h	526	458	0				0	379	284	16	316	0
Grp Sat Flow(s),veh/h/ln	1757	1683	1502				0	1772	1482	1647	1730	0
Q Serve(g_s), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Cycle Q Clear(g_c), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Prop In Lane	0.17		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	902	864					0	644	539	23	716	0
V/C Ratio(X)	0.58	0.53					0.00	0.59	0.53	0.69	0.44	0.00
Avail Cap(c_a), veh/h	902	864					0	644	539	60	755	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	18.6	17.9	0.0				0.0	28.3	27.6	54.5	35.8	0.0
Incr Delay (d2), s/veh	2.8	2.3	0.0				0.0	3.9	3.7	20.0	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.8	8.2	0.0				0.0	8.4	6.2	0.6	8.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.3	20.2	0.0				0.0	32.2	31.2	74.5	36.1	0.0
LnGrp LOS	C	C					A	C	C	E	D	A
Approach Vol, veh/h		984	A					663			332	
Approach Delay, s/veh		20.8						31.8			37.9	
Approach LOS		C						C			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		60.5		49.5			5.5	44.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		54.0		48.0			4.0	39.2				
Max Q Clear Time (g_c+I1), s		24.9		20.5			3.1	21.0				
Green Ext Time (p_c), s		13.6		0.9			0.0	2.0				

Intersection Summary			
HCM 6th Ctrl Delay			27.4
HCM 6th LOS			C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Future Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	200	895	158	11	789	21	105	26	11	53	21	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	599	2196	979	24	1025	457	203	263	111	341	39	293
Arrive On Green	0.35	0.65	0.65	0.01	0.32	0.32	0.21	0.22	0.21	0.21	0.22	0.21
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	200	895	158	11	789	21	105	0	37	53	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.5	13.8	4.5	0.7	24.3	1.1	8.9	0.0	1.9	3.5	0.0	11.6
Cycle Q Clear(g_c), s	9.5	13.8	4.5	0.7	24.3	1.1	20.5	0.0	1.9	5.4	0.0	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	599	2196	979	24	1025	457	203	0	374	341	0	332
V/C Ratio(X)	0.33	0.41	0.16	0.45	0.77	0.05	0.52	0.00	0.10	0.16	0.00	0.54
Avail Cap(c_a), veh/h	599	2196	979	74	1323	590	236	0	419	378	0	372
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.0	9.1	7.4	53.7	33.9	26.0	47.6	0.0	34.5	36.8	0.0	38.6
Incr Delay (d2), s/veh	0.2	0.6	0.4	7.9	5.6	0.2	1.5	0.0	0.1	0.2	0.0	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	5.0	1.5	0.3	10.0	0.4	2.9	0.0	0.8	1.2	0.0	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.2	9.6	7.8	61.7	39.5	26.2	49.1	0.0	34.5	37.0	0.0	39.7
LnGrp LOS	C	A	A	E	D	C	D	A	C	D	A	D
Approach Vol, veh/h		1253			821			142			232	
Approach Delay, s/veh		12.0			39.5			45.3			39.0	
Approach LOS		B			D			D			D	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	5.6	76.3	28.1	43.0	38.9	28.1
Change Period (Y+Rc), s	4.5	* 4.5	5.5	4.5	4.0	5.5
Max Green Setting (Gmax), s	4.5	* 66	25.5	25.5	45.0	25.5
Max Q Clear Time (g_c+I1), s	2.7	15.8	13.6	11.5	26.3	22.5
Green Ext Time (p_c), s	0.0	19.2	0.6	0.4	8.6	0.1

Intersection Summary	
HCM 6th Ctrl Delay	25.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	150	35	800	25	40
Future Vol, veh/h	740	150	35	800	25	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	779	158	37	842	26	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	937	0	1274	390
Stage 1	-	-	-	-	779	-
Stage 2	-	-	-	-	495	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	703	-	162	614
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	584	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	703	-	153	614
Mov Cap-2 Maneuver	-	-	-	-	153	-
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	553	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	19.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	153	614	-	-	703	-
HCM Lane V/C Ratio	0.172	0.069	-	-	0.052	-
HCM Control Delay (s)	33.4	11.3	-	-	10.4	-
HCM Lane LOS	D	B	-	-	B	-
HCM 95th %tile Q(veh)	0.6	0.2	-	-	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Future Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	153	663	5	106	784	5	5	5	5	26	0	116
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	678	1754	789	704	1662	11	235	3	3	207	0	7
Arrive On Green	0.11	0.53	0.53	0.09	0.50	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3321	21	581	581	581	313	0	1395
Grp Volume(v), veh/h	153	663	5	106	385	404	15	0	0	142	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	1712	1743	0	0	1707	0	0
Q Serve(g_s), s	1.1	2.4	0.0	0.8	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.1	2.4	0.0	0.8	3.2	3.2	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.01	0.33		0.33	0.18		0.82
Lane Grp Cap(c), veh/h	678	1754	789	704	816	857	240	0	0	214	0	0
V/C Ratio(X)	0.23	0.38	0.01	0.15	0.47	0.47	0.06	0.00	0.00	0.66	0.00	0.00
Avail Cap(c_a), veh/h	2187	10812	4861	1697	4725	4963	2496	0	0	2385	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	3.5	2.9	2.3	3.5	3.4	3.4	10.4	0.0	0.0	10.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.1	0.0	0.1	0.3	0.3	0.1	0.0	0.0	2.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.6	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.7	3.0	2.3	3.6	3.7	3.7	10.5	0.0	0.0	13.0	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	B	A	A	B	A	A
Approach Vol, veh/h		821			895			15			142	
Approach Delay, s/veh		3.1			3.7			10.5			13.0	
Approach LOS		A			A			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.3	14.4		0.0	5.8	14.9		0.0				
Change Period (Y+Rc), s	4.0	7.0		4.0	4.0	7.0		4.0				
Max Green Setting (Gmax), s	21.0	57.0		27.0	14.0	64.0		27.0				
Max Q Clear Time (g_c+I1), s	3.1	5.2		0.0	2.8	4.4		0.0				
Green Ext Time (p_c), s	0.3	2.2		0.0	0.2	2.2		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			4.2									
HCM 6th LOS			A									

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Future Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	684	5	105	884	53	5	5	5	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	937	0	0	689	0	0	1346	1841	342	1476	-	-
Stage 1	-	-	-	-	-	-	694	694	-	1121	-	-
Stage 2	-	-	-	-	-	-	652	1147	-	355	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	727	-	-	901	-	-	110	74	654	88	0	0
Stage 1	-	-	-	-	-	-	399	442	-	220	0	0
Stage 2	-	-	-	-	-	-	423	272	-	635	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	727	-	-	901	-	-	100	65	654	74	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	100	65	-	74	-	-
Stage 1	-	-	-	-	-	-	396	439	-	218	-	-
Stage 2	-	-	-	-	-	-	374	240	-	618	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	1	42.7	61.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	111	727	-	-	901	-	-	74
HCM Lane V/C Ratio	0.142	0.007	-	-	0.117	-	-	0.142
HCM Control Delay (s)	42.7	10	-	-	9.5	-	-	61.6
HCM Lane LOS	E	A	-	-	A	-	-	F
HCM 95th %tile Q(veh)	0.5	0	-	-	0.4	-	-	0.5

SECTION 3. BENEFIT COST ANALYSIS MEMO

DRAFT TECHNICAL MEMORANDUM

DATE: July 26, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates
Chris Beatty, Jeff Elston | HHPR
Joel Ainsworth | ECONOrthwest
Darci Rudzinski | APG

SUBJECT: Sandy Bypass Feasibility Reevaluation – Benefit Cost Analysis P# 20020-007

This memorandum presents the benefit cost analysis that was conducted to support the reevaluation of the US 26 bypass project that is identified in the 2011 Sandy Transportation System Plan (TSP). The goal of the analysis is to provide a planning-level assessment of the potential benefits and costs associated with the bypass using measures of performance related to the value of travel time, safety, and local businesses. The Sandy TSP is currently being updated and will incorporate the findings and recommendations from this assessment when developing the motor vehicle project list and priorities.

The following sections present the US 26 preferred conceptual alignment and the benefit cost analysis for value of time, safety, and local businesses.

PREFERRED CONCEPTUAL ALIGNMENT

To support the benefit cost analysis, a conceptual alignment (10% design) and planning-level cost estimate was developed for the bypass. The US 26 bypass conceptual alignment developed for the 2011 Sandy TSP was refined based on updated future traffic operations and more detailed design considerations for topography, environmental constraints, and freeway design standards.

The conceptual alignment for the bypass is shown in Figure 1 and Appendix Section 1. The bypass features and design parameters are summarized below.

- The facility would be located south of the Sandy Urban Growth Boundary and approximately 5.8 miles long.
- The west end of the bypass would connect to US 26 approximately 2,400 feet west of Orient Drive. The new intersection on US 26 would be an interchange configuration.
- The east end of the bypass would connect to US 26 at Firwood Road (Shorty's Corner). The existing intersection would be converted to an interchange configuration.
- The new bypass intersection with OR 211 would be an interchange configuration.
- The bypass facility would provide a grade separated overcrossing at 362nd Drive.

- The facility would provide a 120-foot-wide right-of-way to accommodate four travel lanes (two each direction), raised median, shoulder area, lighting, trees and public utility easement.

FIGURE 1: US 26 BYPASS CONCEPTUAL ALIGNMENT

The primary purpose of the bypass is to serve regional traffic demand that currently travels on US 26 through Sandy. The interchanges at each end of the bypass and OR 211 would provide the primary access to the bypass. The rest of the facility would be limited to right-in/right-out access at key intersections to reduce conflicts and provide reliable free-flow traffic operations. The remaining streets that intersect the bypass conceptual alignment would be closed and an alternative street network would be provided. The conceptual alignment and potential network changes are shown in Appendix Section 1.

A cost estimate was prepared based on the 10% design concept for the bypass shown in Figure 1. The total cost estimate accounts for construction, utility and slope easements, right-of-way acquisition and professional services to administer design and construction management. The cost estimate is approximately $365 to $390 million in current year 2021 dollars. The detailed cost estimate is shown in Appendix Section 2. The cost estimate when adjusted for inflation to represent year 2040 is approximately $980 million to $1 billion. Construction in 2040 is the soonest the bypass could reasonably be built due to magnitude of the project related to regulatory and funding challenges.

VALUE OF TIME IN TRAVEL

To identify potential benefits and costs associated with the US 26 bypass, a traffic analysis was conducted to provide a comparison of the future network improvement alternatives listed below. The supporting transportation data, analysis, and findings used for this benefit cost analysis are documented in the Future Transportation System Performance memo[1] in the Appendix Section 3. This includes a detailed description of the projects and improvements included in each alternative.

- 2040 No Build Alternative includes the extension of Dubarko Road to SE Vista Loop Drive (west).
- 2040 Alternative #1 includes a significant investment in local enhancements and minor improvements to US 26.
- 2040 Alternative #3 adds the US 26 bypass to Alternative #1.

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the peak hour in year 2040. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the south portion of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 1 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 1: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:35	09:55
2040 NO BUILD		16:50	14:25
2040 ALTERNATIVE #1		13:20	10:15
2040 ALTERNATIVE #3	TRAVEL ON US 26 FACILITY	08:55	10:20
	TRAVEL ON BYPASS FACILITY	07:55	07:55

[1] Future Transportation System Performance memo, DKS Associates, June 28, 2021.

The future year 2040 travel time estimates developed for the No Build, Alternative #1, and Alternative #3 were used to evaluate potential future travel time benefits. With the bypass facility, year 2040 travel times through Sandy would result in the travel time savings shown in Table 2.

TABLE 2: ESTIMATED US 26 CORRIDOR TRAVEL TIMES SAVINGS (PEAK HOUR)

ALTERNATIVES COMPARED	TRAVEL TIME SAVINGS EASTBOUND (MM:SS)	TRAVEL TIME SAVINGS WESTBOUND (MM:SS)
2040 NO BUILD TO ALTERNATIVE #3	- 8:55	- 6:30
2040 ALTERNATIVE #1 TO ALTERNATIVE #3	- 5:25	- 2:20

The value of time in travel savings (VTTS) was estimated to measure a potential benefit of the bypass. The Benefit-Cost Analysis Guidelines for Discretionary Grant Programs[2] was the source for the value of travel time savings (cost per person hour) and average vehicle occupancy inputs in the calculations. Detailed assumptions are provided in Appendix Section 4.

The total VTTS was estimated at $19.21 per person hour for travel along US 26. This value was adjusted to reflect a slightly higher VTTS than the national average based on slightly higher household income and employee compensation in the City of Sandy and the Portland-Vancouver-Hillsboro metropolitan area. The VTTS for commercial traffic was estimated at $32.19 per person hour. This is consistent with the national rates recommended and scaled to 2021 dollars.

Based on the travel time savings between Alternative #1 and Alternative #3 shown in Table 2, the hourly benefit during the 2040 peak hour is approximately $1,900. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $500,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $3,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $37.4 million.

Comparing No Build and Alternative #3, the hourly benefit during the 2040 peak hour is approximately $3,700. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $1,000,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $6,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $74.8 million.

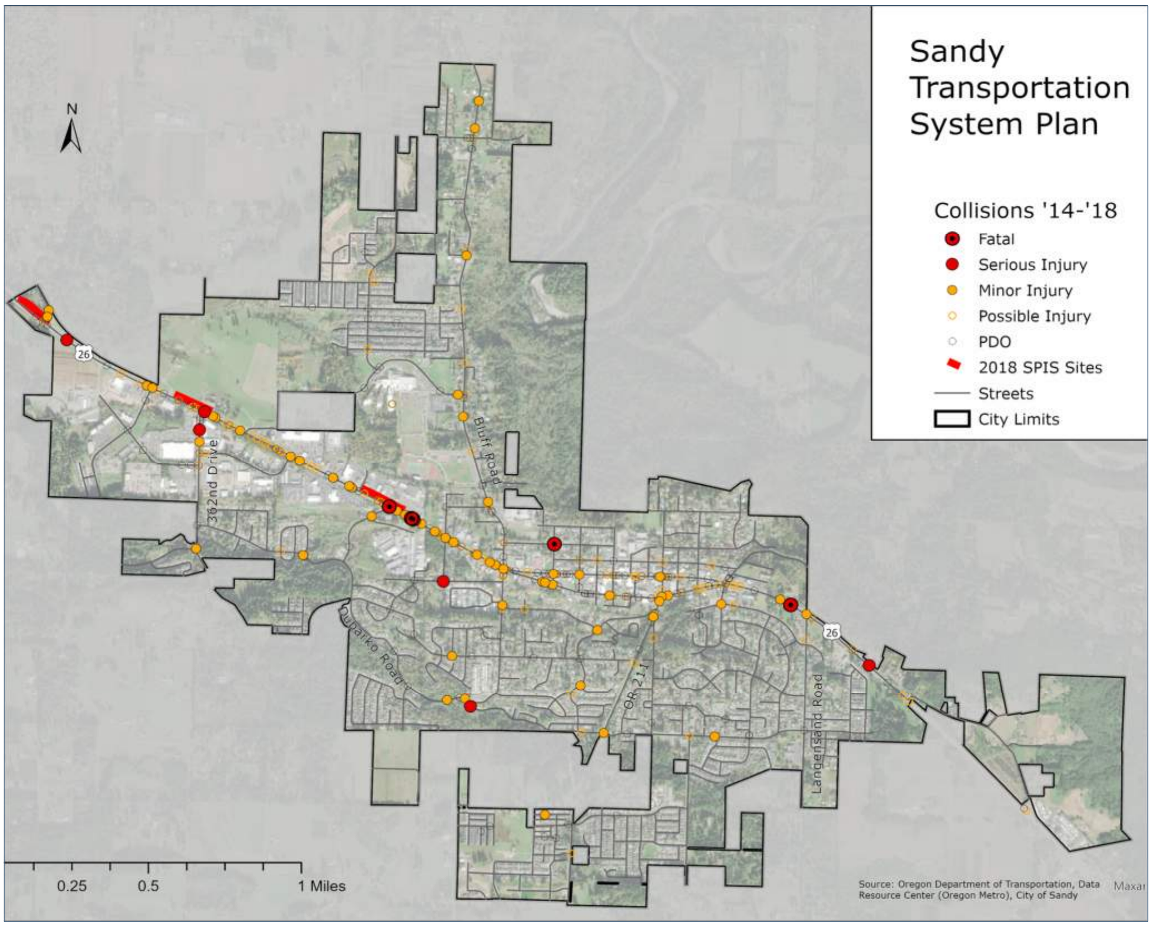
[2] Benefit-Cost Analysis Guidelines for Discretionary Grant Programs, USDOT, December 2018.

SAFETY ANALYSIS

COLLISION DATA

A safety analysis was conducted for US 26 between the end points of the bypass conceptual alignment. The most recent five years of available collision data, 2014 to 2018, was reviewed to document the severity of collisions and calculate the crash rate. The collision data compiled for the Sandy TSP Update is shown in Figure 2 and includes the US 26 safety data used for this analysis.

FIGURE 2: SANDY SAFETY ASSESSMENT – 2014 TO 2018



The crash records were summarized by study intersection for intersection-related crashes in Table 2 and non-intersection related crashes by study segments are summarized in Table 3. In total, the study corridor experienced 338 crashes over the five-year study period, including four fatal crashes and five serious injury crashes. The following key findings are summarized below all 338 crashes:

- All four fatal crashes involved a driver under the influence of alcohol or drugs.

- Three of the four crashes involved a pedestrian fatality.
- Two fatal crashes occurred in front of the Safeway along US 26 between Ruben Ln and Industrial Way.

- The most common crash type was rear-end crashes (53%) and the top contributing factor was failure to avoid (34%).
- The study intersection of 362nd Dr and US 26 reported the highest number of crashes and the highest crash rate. Whereas the intersection of US 26 and Ruben Ln experienced the highest number of high severity crashes (one fatal and two serious injury crashes).
- The study segment between Ruben Ln and Bluff Rd experienced the highest number of crashes and the highest crash rate, including two fatal crashes.
- One in four crashes occurred on wet road surface conditions.

TABLE 2: US 26 INTERSECTION COLLISION DATA (2014 TO 2018)

STUDY INTERSECTION	FATAL	INJURY	PROPERTY DAMAGE ONLY	TOTAL[A]	CRASH RATE [B]
ORIENT DR/US 26	0	1	2	3	0.053
362ND DR/US 26	0	25	10	35	0.566
INDUSTRIAL WAY/ US 26	0	6	5	11	0.201
RUBEN LN/US 26	1	13	4	18	0.309
BLUFF RD/US 26	0	9	10	19	0.311
MEINIG AVE (OR 211)/PROCTER BLVD (US 26)	0	4	6	10	0.391
MEINIG AVE (OR 211)/PIONEER BLVD (US 26)	0	6	5	11	0.290
TEN EYCK RD/US 26	0	7	5	12	0.293
LANGENSAND RD/US 26	0	4	2	6	0.182
VISTA LOOP DR W/US 26	0	0	0	0	0
VISTA LOOP DR E/US 26	0	0	0	0	0

[A] Intersection crashes were filtered to crashes that were only intersection related.
[B] Crash rate is calculated based on FHWA intersection crash rate calculation: https://safety.fhwa.dot.gov/local_rural/training/fhwasa1210/s3.cfm

Overall, the 11 study intersections experienced a total of 125 crashes, including one fatal crash and three serious injury crashes. The following key findings for 125 intersection related crashes are summarized below:

- One fatal crash occurred at the intersection of Ruben Ln and US 26 that involved a driver, who was reported under the influence of alcohol, driving westbound along US 26 and disregarded the traffic signal and hit a pedestrian crossing the crosswalk.

- Two of the three serious injury crashes involved a vehicle making a turning movement from the westbound approach at Ruben Ln and US 26.
- 362nd Dr and US 26 intersection reported the highest number of crashes and the highest crash rate compared to the other study intersection.
- The top three collision types reported at the study intersections were rear-end (49%), turning (35%), and pedestrian related (6%).
- The top three contributing circumstances were reported failure to avoid (36%), failure to yield (24%), and disregarding the signal (8%).
- 31% of crashes were reported on wet road surface conditions.

TABLE 3: US 26 SEGMENT COLLISION DATA (2014 TO 2018)

HIGHWAY SEGMENT	LENGTH (MILES)	FATAL	INJURY	PROPERTY DAMAGE ONLY	TOTAL	CRASH RATE[A]
1000 FEET WEST OF ORIENT DR – ORIENT DR	0.189	0	0	1	1	9.676
ORIENT DR – 362ND DR	0.602	0	10	9	19	66.104
362ND DR – INDUSTRIAL WAY	0.326	0	19	4	23	141.466
INDUSTRIAL WAY – RUBEN LN	0.368	0	18	9	27	139.838
RUBEN LN – BLUFF RD	0.421	2	39	20	61	283.660
BLUFF RD – MEINIG AVE (OR 211) ON PIONEER BLVD	0.526	0	7	13	20	119.152
BLUFF RD – MEINIG AVE (OR 211) ON PROCTOR BLVD	0.523	0	8	19	27	206.289
MEINIG AVE (OR 211) – TEN EYCK RD ON PIONEER BLVD	0.215	0	5	5	10	174.438
MEINIG AVE (OR 211) – TEN EYCK RD ON PROCTOR BLVD	0.204	0	2	5	7	161.571
TEN EYCK RD – LANGENSAND RD	0.292	1	4	1	6	56.007
LANGENSAND RD – VISTA LOOP DR EAST	1.030	0	6	6	12	24.366
VISTA LOOP DR EAST – SE LUZON LN	0.188	0	0	0	0	45.903

[A] Crash rate is calculated based on FHWA road segment crash rate calculation: https://safety.fhwa.dot.gov/local_rural/training/fhwasa1210/s3.cfm

Overall, the study corridor experienced a total of 213 crashes that were non-intersection related, including three fatal crashes and two serious injury crashes. The following key findings for 213 segment crashes are summarized below:

- Three fatal crashes occurred over the five-year study period:
    - Two fatal crashes occurred along US 26, between Ruben Lane and Industrial Way, including one pedestrian fatality. Both of these crashes involved a driver reportedly under the influence of drugs.
    - The other fatal crash involved a driver, who was reported under the influence of alcohol and drugs, hit a pedestrian walking eastbound along the shoulder of US 26, between Ten Eyck Rd and Langensand Rd, where there is no sidewalk present.
- The segment along US 26 between Ruben Lane and Bluff Road reported the highest number of crashes and the highest crash rate compared to the other segments.
- The top three collision types reported for segments were rear-end (56%), turning (16%), and sideswipe (13%).
- The top three contributing circumstances were reported failure to avoid (32%), failure to yield (16%), and following too close (14%).
- One in five crashes were reported on wet road surface conditions.
- Eight crashes (4%) reported a driver under the influence of alcohol or drugs, including three fatal crashes and four injury crashes.

BYPASS SAFETY EVALUATION

By rerouting traffic around the main corridor of cities, highway bypasses can provide several direct transportation benefits, including improved roadway safety. A high-level safety evaluation of US 26 was conducted to identify potential safety benefits from the bypass. The evaluation included a review of literature and outcomes from bypass facilities as follows:

California Bypass Study (2006)[3]

This report summarizes the impacts of bypasses for local communities by presenting case studies of bypasses throughout the United States. Based on the case studies found in this report, constructing bypasses can improve traffic safety by reducing the number of conflict points between trucks, automobiles, motorcycles, bicyclists, and pedestrians. In particular, bypasses can divert freight traffic away from downtown areas, and it can improve travel times for goods to be moved between areas. Bypasses can also improve the perception of safety by addressing concerns related to truck traffic, improve local downtown circulation and reduce the idling noise in urban areas. The

[3] Caltrans California Bypass Study (2006): https://rosap.ntl.bts.gov/view/dot/27518

report also summarized case studies of bypasses in other states, such as Iowa, where the bypass increased local business sales “due to local residents taking advantage of easier access to downtown businesses as a result of less traffic congestion, improved traffic safety and easier parking”.

New Roads and Human Health: A Systemic Review (2003)[4]

This journal article conducted a review of 32 different before-and-after bypass studies worldwide and their safety impacts. The research compared the number of injury accidents on the main road through town in the “before” period and the number of injury accidents in the “after” period for both the main road and the new bypass. In particular, a Norway case study conducted a meta-analysis of 20 bypasses that observed a 19% decrease in injury accidents on average. Overall, the bypass studies showed a general decline in the number of injury accidents after the opening of the new bypass facilities.

A Bayesian Assessment of the Effect of Highway Bypasses in Iowa on Crashes and Crash Rate (2011)[5]

This journal article assessed the impact of highway bypasses in the state of Iowa. The study evaluated several years before and after the construction of a bypass for 19 sites and compared them to 6 other “non-treatment” sites. The “non-treatment” sites were six cities that were scheduled to be bypassed but had not started construction prior to the study completion. The research results indicated the construction of the bypasses resulted in improved safety with a reduction of the number of crashes on both the old and new (bypass) road networks considered in the study. On average, the crash frequencies “were reduced by 50% on the old road network and 62% on the new road network”. Also, the “crash rates on average were reduced 33% on the old road network and 59% on the new road network”. Overall, the study concluded that the bypass construction increased traffic safety by reducing the number of crashes.

SAFETY BENEFITS

It is estimated the construction of the US 26 bypass in Alternative #3 would moderately improve safety on US 26 between Orient Drive and Firwood Road. Based on the literature review, it is likely that the number of crashes on US 26 through Sandy will be reduced if proper safety measures are implemented for the bypass construction. In particular, appropriate wayfinding signage and speed limit setting for both the main road and the new bypass should be planned thoughtfully for both local residents and regional travelers. Also, ensuring effective collaboration and consultation with relevant stakeholders, such as law enforcement, will ensure the continued safety for local residents and travelers on both routes. Furthermore, the City of Sandy should consider some educational

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[4] Eagan, M., M. Petticrew, D. Ogilvie, V. Hamilton. 2003. American Journal of Public Health: https://ajph.aphapublications.org/doi/full/10.2105/AJPH.93.9.1463

[5] Lorenzo G. Cena, Nir Keren, Wen Li, Alicia L. Carriquiry, Michael D. Pawlovich, & Steven A. Freeman. (2011). *Journal of Safety Research*: https://doi.org/10.1016/j.jsr.2011.05.007

outreach efforts to inform local residents of how to safely traverse interchanges (merging, diverging and ramps) and to prevent driving under the influence of drugs/alcohol to reduce fatalities.

Overall, the bypass is expected to reduce the number of conflict points and avoid vulnerable travelers (i.e. pedestrians and bicyclists) by rerouting traffic away from the commercial and downtown areas.

BENEFITS OR IMPACTS TO LOCAL BUSINESSES

To establish a baseline understanding of the potential effect of highway bypasses on communities similar to Sandy, available economic literature was reviewed and summarized in the following sections. This information is intended to inform the range of potential benefits or impacts to local businesses from the estimated reduction in vehicle trips on US 26 through Sandy.

CHARACTERISTICS OF BYPASSES

Bypasses arise out of a need to correct safety and traffic concerns for state highways that are serving as both a regional highway and main street by diverting traffic away from a downtown or urban area and providing alternative routes for through traffic. Ideally, this has the potential to improve local access to goods and services for residents and visitors by decreasing traffic delays.[6] Bypasses can be used to enhance quality of life (e.g., less noise and air pollution), add roadway capacity for existing or anticipated traffic needs, and upgrade existing roadway conditions.[7]

When urban activities become more centered around highways, highways may be unable to efficiently serve the community and are instead used for local trips—as opposed to through traffic. Downtown areas need parking access for businesses and safe, walkable environments while regional travel areas need fewer stops, higher speeds, and limited access facilities.

In Oregon, new bypasses can take the form of freeways or expressways and can be located within an Urban Growth Boundary (UGB) and/or outside of a UGB, with a Transportation Planning Rule goal exception. The primary distinction between these two roadways is the degree of local access. Freeways are high speed and have fully controlled access to prioritize through traffic and safety. When access connections are necessary, grade-separated interchanges are integrated.

Expressways have more access, albeit strictly controlled, to manage inter and intra-urban traffic. When expressway connections are necessary, they are at-grade signalized and unsignalized public

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[6] Amendment to 1999 Oregon Highway Plan BYPASS POLICY, April 16, 2003.

[7] System Metrics Group, Inc. et al. 2006. *California Bypass Study, The Economic Impacts of Bypasses: Volume 1: Planning Reference.* Sacramento, CA: California Department of Transportation, Transportation Economics.

road intersections and interchanges. In general, rural areas should not have traffic signals and private-property access is discouraged although some exceptions may apply.[8]

THE IMPACT OF BYPASSES ON SMALL-TOWN ECONOMIES

Some business owners and local stakeholders may express concerns about how a bypass will impact their local economy, while elected officials may view the new infrastructure as an opportunity for economic development. These changes can leave residents and local business owners wondering about the economic impacts of diverted traffic or the competitive effects of potential development adjacent to the new roadway. Economic concerns may include, but are not limited to:

- Will the businesses seeking development opportunities be locally owned or national chains or franchises likely to order their supplies and spend profits elsewhere?
- Will there be a loss of local character if the existing business mix is altered?
- Will new business development adjacent to the bypass increase competition for the existing businesses?

Each of these questions are complex and challenging to predict without extensive project and geographic information. Given the limited scope, this assessment focuses on the characteristics of bypasses that can affect a community's economy. The following section describes those differing characteristics.

HOW CAN A BYPASS IMPACT DIFFERENT TYPES OF TOWNS AND BUSINESSES?

How the construction of a new bypass interacts with a local economy depends on several interrelated factors including the types of services and sectors a town specializes in, the customer base that town appeals to, and its geographic location. Key questions that often arise when attempting to evaluate the economic effect of a bypass on a community's economy are:

- Is the town located along a major trade route or near a large metropolitan area?
- What types of industry does the local economy support?
- Does the town cater primarily to tourists and pass-through traffic or residents?

Answering all these questions is imperative when evaluating the economic impacts of bypasses on local economies. While the variance of economic effects can be wide, some generalized relationships have been established through research. In 2006, the California Department of Transportation (Caltrans) published a comprehensive study[9] that assessed the impacts of bypasses on small-town economies by reviewing existing literature on bypasses, performing field work, and developing a proprietary Highway Bypass Impact (HBI) Model. The authors identified a variety of factors that influence how a bypass interacts with a local, small-town economy.

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[8] Amendment to 1999 Oregon Highway Plan BYPASS POLICY, April 16, 2003.

[9] California Bypass Study, The Economic Impacts of Bypasses, May 2006.

The study identifies several key features that should be considered during the design phase of bypasses:

- Time savings
- Direct access
- Proximity to commercial areas
- Visibility

The time savings drivers incur is a determining factor in how many vehicles will opt to utilize the new bypass over the old route. This feature is one of the most significant benefits from bypasses. Bypasses connected to highway interchanges may impact businesses in one of two ways. One positive feature is that they can increase access to existing businesses if they are located along the bypass. A potential drawback is the bypass could draw traffic away from established businesses, encouraging new development adjacent to the bypass and increasing competition for existing businesses. The availability of parking in commercial areas (e.g., downtown) is a strong indicator of how well existing businesses can withstand potential competition from newly accessible land. And lastly, the more visible a business is from a bypass and the closer the business is to a commercial area (e.g., downtown), the less likely it is to experience negative effects from new traffic flows.

Communities with heavy local traffic or through traffic that does not stop are the least likely to be impacted by bypasses while communities that provide goods and services to pass-through traffic are most likely to experience adverse effects. In essence, the more a community relies on local traffic, the less likely the new bypass will impact businesses because there is an existing customer base. Even though local traffic-dependent communities may not stand to gain much from the addition of a bypass, they could experience increased and more efficient traffic flows if a bypass reduces truck traffic.

Residential communities and tourist destinations are the most likely to benefit from bypasses resulting in less traffic congestion and increased safety. Local business owners in these areas may have to partner with government officials to mitigate any potential negative impacts from the new traffic patterns. These strategies could involve capital improvements (e.g., increasing walkability, additional parking) or downtown redevelopment. Towns that offer a variety of visitor services (e.g., hotels, art galleries) attract more tourists as opposed to travelers passing through on their way to somewhere else and may experience positive economic impacts if a downtown area serves as a destination.

The types of towns that will have the most difficult time transitioning their economy after a bypass is constructed are those that are highway oriented. In particular, businesses that cater to pass-through traffic, like fast food chains and gas stations, are the most likely to be affected by bypasses. One critical question for these types of communities is whether travelers make opportunistic stops or if they incorporate the stop into their travel plans ahead of time? If travelers plan in advance on stopping at a particular location, ensuring convenient access for them is crucial to maintain the health of local businesses. If the businesses are more opportunistic for travelers, then advertising and proximity to the bypass is imperative. For example, tourist-related businesses can mitigate negative impacts by relocating to properties adjacent to the bypass.

RESEARCH SUMMARY

Throughout the 1990s and 2000s, researchers and local and state governments evaluated the impacts of bypasses on local economies. A broad range of studies and reports emerged with many focusing on small-town economies.

In 1998, the Wisconsin Department of Transportation (WisDOT) published a report that analyzed the impact of bypasses on 17 smaller communities[10] relative to 14 control communities since 1980. Researchers found that average traffic patterns over the long term on the older routes in the medium-to-large communities were close to the pre-bypass counts.[11] Overall, residents and business owners viewed the bypasses as beneficial, citing development opportunities, less truck traffic, and improved traffic flows. These effects allowed businesses—retail and traffic-dependent businesses, in particular—to flourish and the medium-to-large communities to experience continued economic growth. Additionally, the bypasses caused little relocation of retail businesses adjacent to the new roadway. Despite these positives, the authors noted that bypasses had an increased potential for harm to communities with fewer than 1,000 residents.[12]

Similar to WisDOT's study, the Texas Department of Transportation (TxDOT) asked researchers to perform an analysis investigating the economic impacts of highway bypasses on small communities. While business owners, residents, and local elected officials held mixed reviews of the bypasses initially, they felt that traffic congestion had greatly improved, subsequently increasing safety and local business access. Despite these positives, the traffic diversion had negative impacts on highway-oriented businesses (e.g., service stations, motels, fast food restaurants), downtown businesses, and those along the bypass. However, the authors noted these impacts were not uniformly distributed and depended largely on the function of the downtown area, in particular whether the area focused on civic or service-related businesses.[13]

In 2001, the University of Kentucky Center for Business and Economic Research performed an analysis with the Kentucky Transportation Center to assess the impacts of bypasses on both local economies and quality of life. Researchers found that the construction of new bypasses did impact retail sales, but not overall employment. Employment growth was likely to increase if the bypasses were located near a city's business district. Other key findings included the size of a community was not a determinant in employment growth and some rearrangement of economic activity resulted from bypasses (e.g., increased vacancy rates in downtown areas). Residents reported

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[10] These communities ranged from 300 to 30,000 residents.

[11] According to the authors, most of the bypass communities had experienced a significant amount of economic growth prior to the construction of the new infrastructure and exceeded the growth in the control (i.e., non-bypass) communities.

[12] Wisconsin Department of Transportation. 1998. *The Economic Impacts of Highway Bypasses on Communities, Summary*.

[13] Civic-related businesses include courts, bail bonds companies, title companies, and law offices.

greater satisfaction with improved traffic flows and most downtown business owners felt that the bypass either assisted them or had no meaningful impact on their businesses.[14]

A larger study conducted through the National Cooperative Highway Research Program (NCHRP) used national survey data from both the United States and Canada to assess the impacts of bypasses on smaller economies (i.e., 5,000 residents). While the findings were largely inconclusive, the authors did determine that highway-oriented businesses in small towns were the most negatively impacted by traffic diversions and that perceived effects were more profound than the actual effects. Although there was an observed initial drop in sales, the local economies typically recovered due to decreased congestion and noise pollution. Small and rural communities stood to benefit as development potential along the new roadway and traffic safety increased. Additionally, land values increased along both the new bypasses and old routes. The researchers also concluded that population density had a large effect on a community's economic performance following bypass construction and that a town's ability to extend its political boundaries (and subsequently garner additional tax revenue from development) could have a positive impact as well.[15]

POTENTIAL IMPACTS FOR SANDY

Accounting for a city's unique characteristics and commercial competition outside the city is the only way to truly assess how a particular economy may be impacted by a new bypass. The City of Sandy is a mixed economic environment with local and big-box businesses. Many are auto-oriented and cater to highway pass through traffic such as gas stations, convenience stores, drive-through coffee shops and fast food/high turnover restaurants. A major segment of retail customers are recreational visitors travelling through Sandy to Mt. Hood and Central Oregon. These unique customers support specialized local businesses such as outdoor equipment stores.

Some of these businesses serving pass through traffic may see an impact if their services cannot be easily replaced. For example, customers will need to determine if the travel time savings from taking the bypass outweighs the convenience of shopping in Sandy. Customers may choose to shop near their home before they leave or at their destination instead. Other auto-oriented businesses, such as gas stations, will likely be impacted. Customers may choose to stop for gas outside Sandy to save time travelling on the bypass. There are several gas stations to the east and west of Sandy within a few miles. The existing gas station at Firwood Road (Shorty's Corner) would be conveniently located on the east end of the bypass. Note that Sandy has a local gas tax that generates revenue to fund various transportation needs including facility maintenance. The diversion of vehicles to the bypass would likely reduce local gas tax revenue.

With the forecasted local growth over the next 20 years, it is unlikely these businesses would experience a high impact from a bypass. An analysis of employment inflow and outflow from

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[14] Thompson, E., J., Miller, and J., Roenker. 2001. *The Impact of a New Bypass Route on the Local Economy and Quality of Life, Research Report KTC-01-10/SPR219-00-21*. June 2001. Lexington, KY: University of Kentucky.

[15] National Cooperative Highway Research Program (NCHRP). 1996. "Effects of Highway Bypasses on Rural Communities and Small Urban Areas." *Research Results Digest* Number 210.

2018[16] (the most recent year available) showed that approximately 5,000 Sandy residents work outside of the city, 3,000 workers commute into the city, and 600 residents work within the city. Of the jobs within Sandy, most are classified as retail trade (~1,000 or 25%) followed by accommodation and food services (~500, 15%) and educational services (~400, 12%). Of these, retail and food services may be the most vulnerable to impacts from a bypass.

The majority of the bypass alignment is outside the urban growth boundary with rural zoning and land use. Urban development would be prohibited, eliminating the possibility for new commercial development along the bypass that could compete with existing businesses on US 26. The biggest commercial competition is the Portland Metro area, approximately seven miles west of Sandy, which can provide almost all the retail and service businesses highway drivers could need.

The bypass is forecasted to serve 1,500 vehicles peak hour in the 2040 peak hour. A portion of these vehicles are potential Sandy business customers that choose the travel time savings of the bypass over the convenience of shopping at a business on US 26. To counter that impact, lower traffic volumes on the highway may make downtown highway fronting businesses more attractive.

OTHER CONSIDERATIONS

There are other potential benefits and costs related to constructing a bypass that should be considered beyond the value of travel time, safety and local businesses previously presented. These other considerations include maintenance of the facility and policy and regulatory requirements as descripted in the following sections.

US 26 JURISDICTIONAL TRANSFER TO CITY

A new bypass facility would be constructed and operated by ODOT. With the bypass in place, ODOT would transfer the jurisdiction of the existing section of US 26 being bypassed to the City. The ongoing maintenance and operation of the facility would be a cost burden for the City. This segment of US 26 is approximately 5 miles long with four to five travel lanes, street lighting and numerous traffic signals. The average annual cost to maintain a comparable urban highway is $20,000 to $30,000 per miles. Over the next 20 years, the maintenance cost for the City is estimated to be $2 to $3 million.

The City taking jurisdiction of US 26 also brings opportunities to make local changes to the facility. With the bypass in place, the future traffic volumes on US 26 will decrease significantly and potentially allow the reconstruction of the existing five-lane sections (outside the downtown couplet) to three-lanes and provide additional design features such as landscaping, wider sidewalks, protected bicycle lanes, median treatments, and diagonal parking with the extra roadway width. This would result in benefits to overall safety and livability and encourage more walking, biking, and transit activity. Reconstruction of US 26 would be a major capital project with

[16] https://onthemap.ces.census.gov/

potential modifications to traffic signals, drainage, utilities, street lighting, pavement markings and signage. Based on planning level cost estimates for comparable corridor reconstruction projects, the cost estimate could range from $20 to $40 million for improvements.

POLICY AND REGULATORY REQUIREMENTS

A detailed evaluation of the policy and regulatory considerations associated with a potential bypass was conducted for this analysis, as provided in the Appendix, Section 4 and summarized below.

The construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

A preferred bypass alternative would be documented in a facility plan, ultimately adopted by the Oregon Transportation Commission (OTC) and Oregon Department of Transportation (ODOT), thereby amending the Oregon Highway Plan (OHP). The City of Sandy and Clackamas County will need to work collaboratively on developing any necessary amendments to local plans (such as the comprehensive plan, TSPs, local land use, and subdivision codes) to ensure consistency with the facility plan for the proposed bypass. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities for the different levels of government are not the same.

Both the City of Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. Local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. New ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that the access management, the land use management, and the coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County.

If the preferred bypass alignment impacts County land designated for EFU or Forest use, the County would need to support adoption with goal exception findings.[17] Following successful local adoption by the City and County, the facility plan could be presented to the OTC for its review and approval.

[17] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)

SUMMARY

To support the reevaluation of the US 26 bypass project, a planning-level assessment of the potential benefits and costs of the bypass was conducted with measures of performance related to various measures. The key findings are summarized in Table 4. These findings will contribute to the content and analysis in subsequent memoranda including the Sandy Bypass Feasibility Reevaluation Report.

TABLE 4: COST AND BENEFIT SUMMARY OF BYPASS FACILITY

Measure	Cost/Impact	Benefit	Consideration
Project Planning and Construction	$980 million to $1 billion for construction, right-of-way acquisition, easements, design and construction management		The cost estimate is for planning purposes only and could change significantly due to the high level of uncertainty regarding the construction year, NEPA process and final design and alignment.
Future Volume and Travel Time		Bypass estimated to serve 1,500 vehicles per hour in 2040 peak hour. Bypass compared to 2040 No Build alternative peak hour: Estimated to save 9 minutes eastbound and 6.5 minutes westbound	Other roadway capacity projects are likely to be built by 2040 that would improve US 26 traffic flow and reduce the estimated time savings (5.5 minutes eastbound and 2.5 minutes westbound).
Travel Time Value		$6 million per year, $75 million over 20 years	Cost saving estimate is highly variable depending on future traffic patterns and duration of congested conditions.
Safety		Overall reduction in crashes on US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.	
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.	Current zoning and land use patterns encourage commercial development along the highway. A bypass outside the UGB would not allow for adjacent commercial development. If the bypass was inside the UGB, new adjacent commercial development may compete with businesses on US 26.

Jurisdictional Transfer to City	City would be responsible for US 26 maintenance, estimated to cost $2 to 3 million over next 20 years.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $20 to $40 million	City would need to find new ongoing funding for maintenance. The cost for reconstruction is highly variable due to uncertainty regarding the final design and year of construction.
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.		Amendments to the Oregon Highway Plan require adoption by the OTC and ODOT. A robust NEPA planning process will be needed to address potential impacts to Goal 5 resources and designated forest use lands.

APPENDIX

CONTENTS

DKS

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SHAPING A SMARTER TRANSPORTATION EXPERIENCE™

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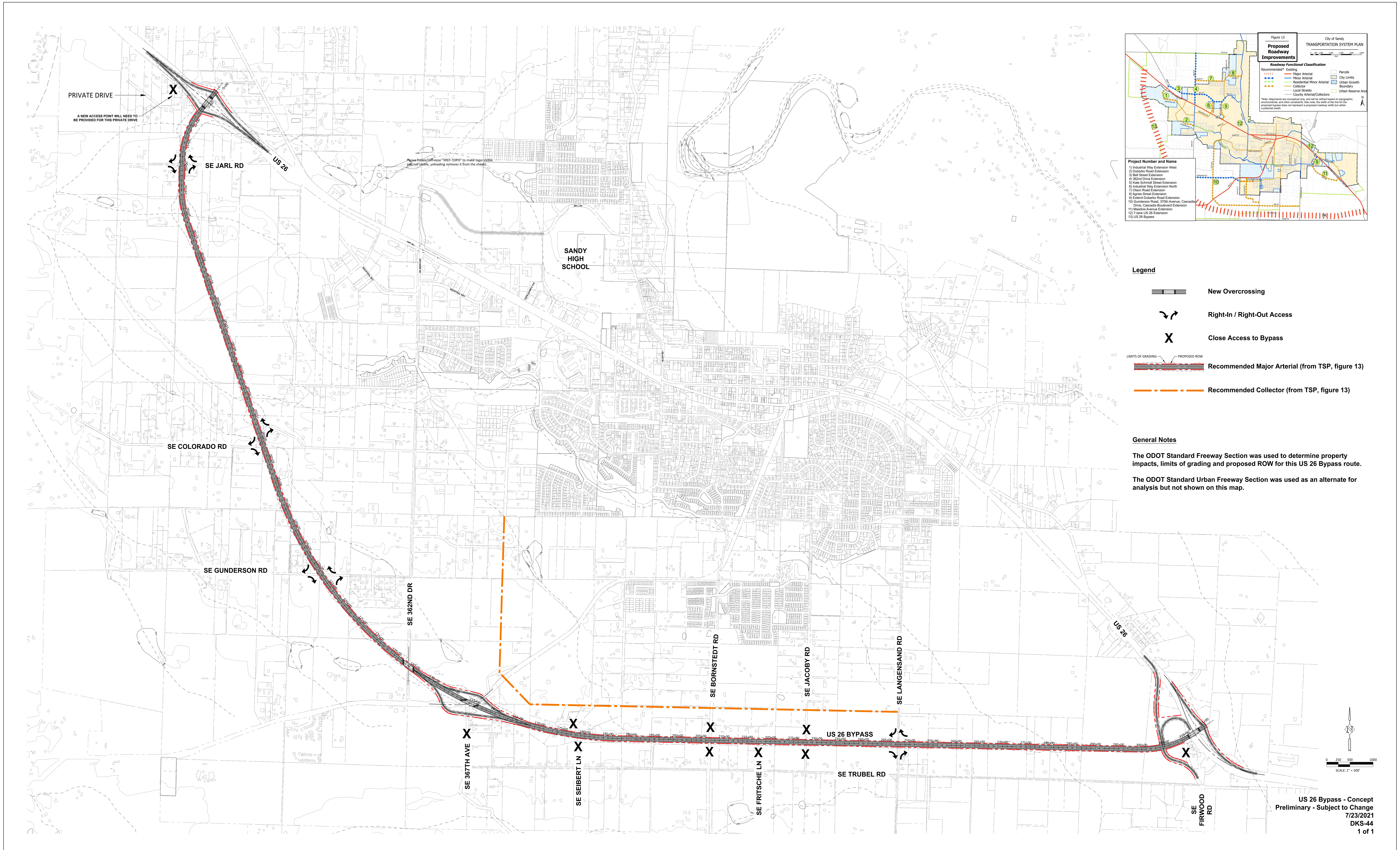
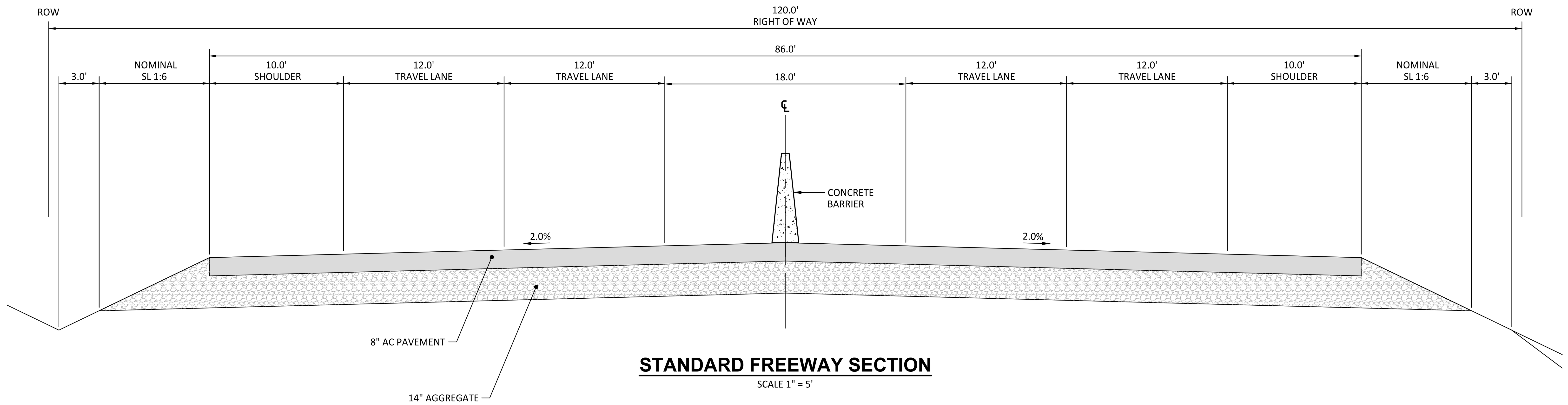
SECTION 1. BYPASS CONCEPT DRAWINGS

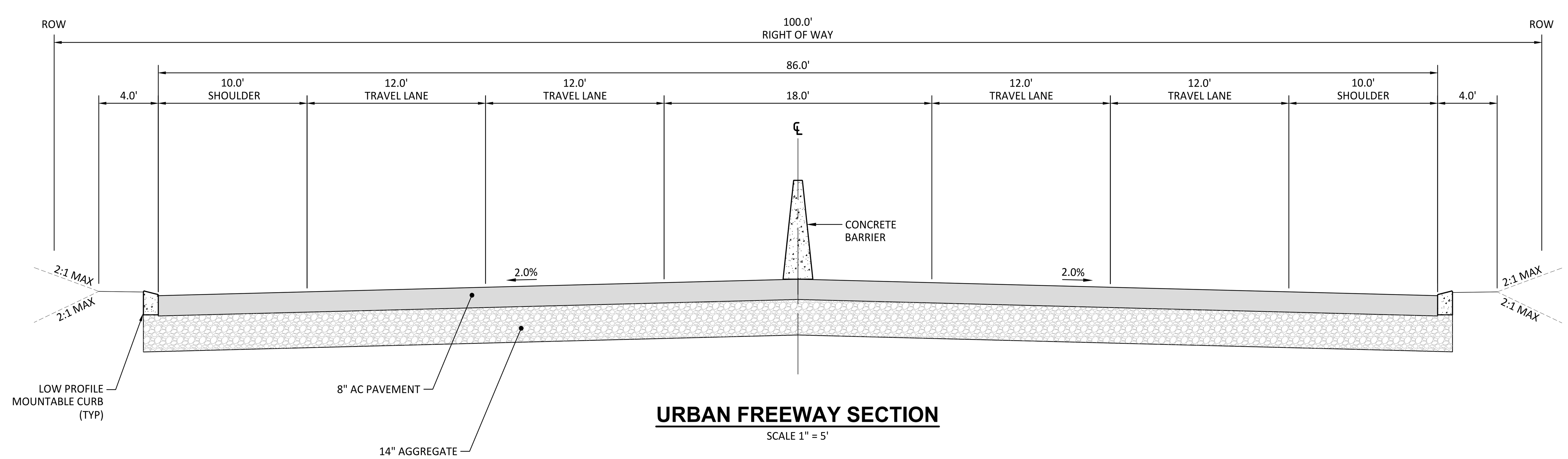


PRIVATE DRIVE
A NEW ACCESS POINT WILL NEED TO BE PROVIDED FOR THIS PRIVATE DRIVE
SE JARL RD
US 26
SANDY HIGH SCHOOL
SE COLORADO RD
SE GUNDERSON RD
SE 362ND DR
SE 367TH AVE
SE SEIBERT LN
SE BORNSTEDT RD
SE FRITSCHE LN
SE JACOBY RD
SE LANGENSAND RD
US 26 BYPASS
SE TRUBEL RD
SE FIRWOOD RD
Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
Legend
New Overcrossing
Right-In / Right-Out Access
Close Access to Bypass
LIMITS OF GRADING
PROPOSED ROW
Recommended Major Arterial (from TSP, figure 13)
Recommended Collector (from TSP, figure 13)
General Notes
The ODOT Standard Freeway Section was used to determine property impacts, limits of grading and proposed ROW for this US 26 Bypass route.
The ODOT Standard Urban Freeway Section was used as an alternate for analysis but not shown on this map.
SCALE: 1" = 500'
US 26 Bypass - Concept
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 1



STANDARD FREEWAY SECTION

SCALE 1" = 5'



URBAN FREEWAY SECTION

SCALE 1" = 5'

US 26 Bypass - Typical Sections
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 1

Legend

↷↱	Right-In / Right-Out Access
X	Close Access to Bypass
	Proposed ROW
	Proposed CL
	Proposed limit of grading
	Drainageway crossing with proposed 3 sided bridge or open bottom box culvert

General Notes

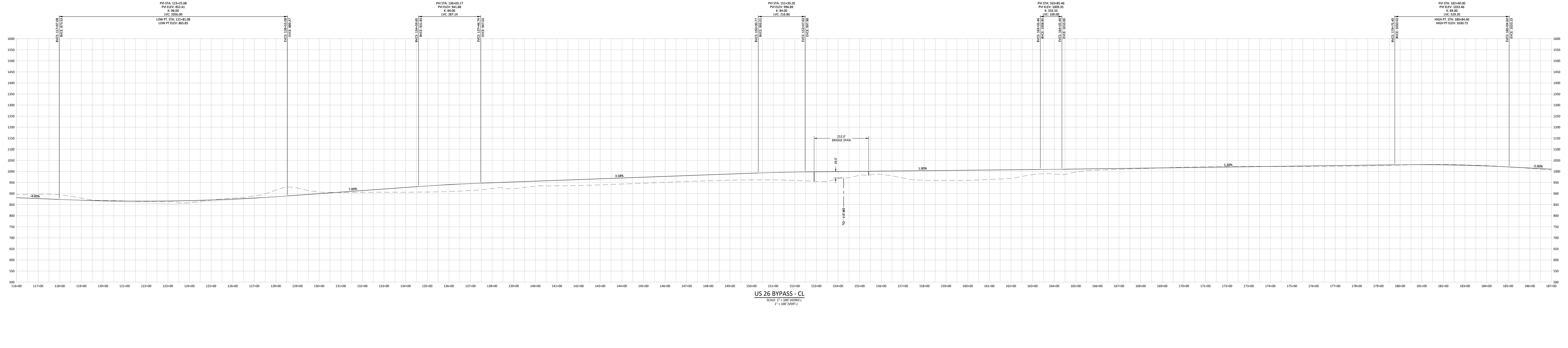
The ODOT Standard Freeway Section was used to determine property impacts, limits of grading and proposed ROW for this US 26 Bypass route.

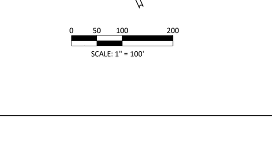
The ODOT Standard Urban Freeway Section was used as an alternate for analysis but not shown on this map.

0 50 100 200

SCALE: 1" = 100'

US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 4





US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
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US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
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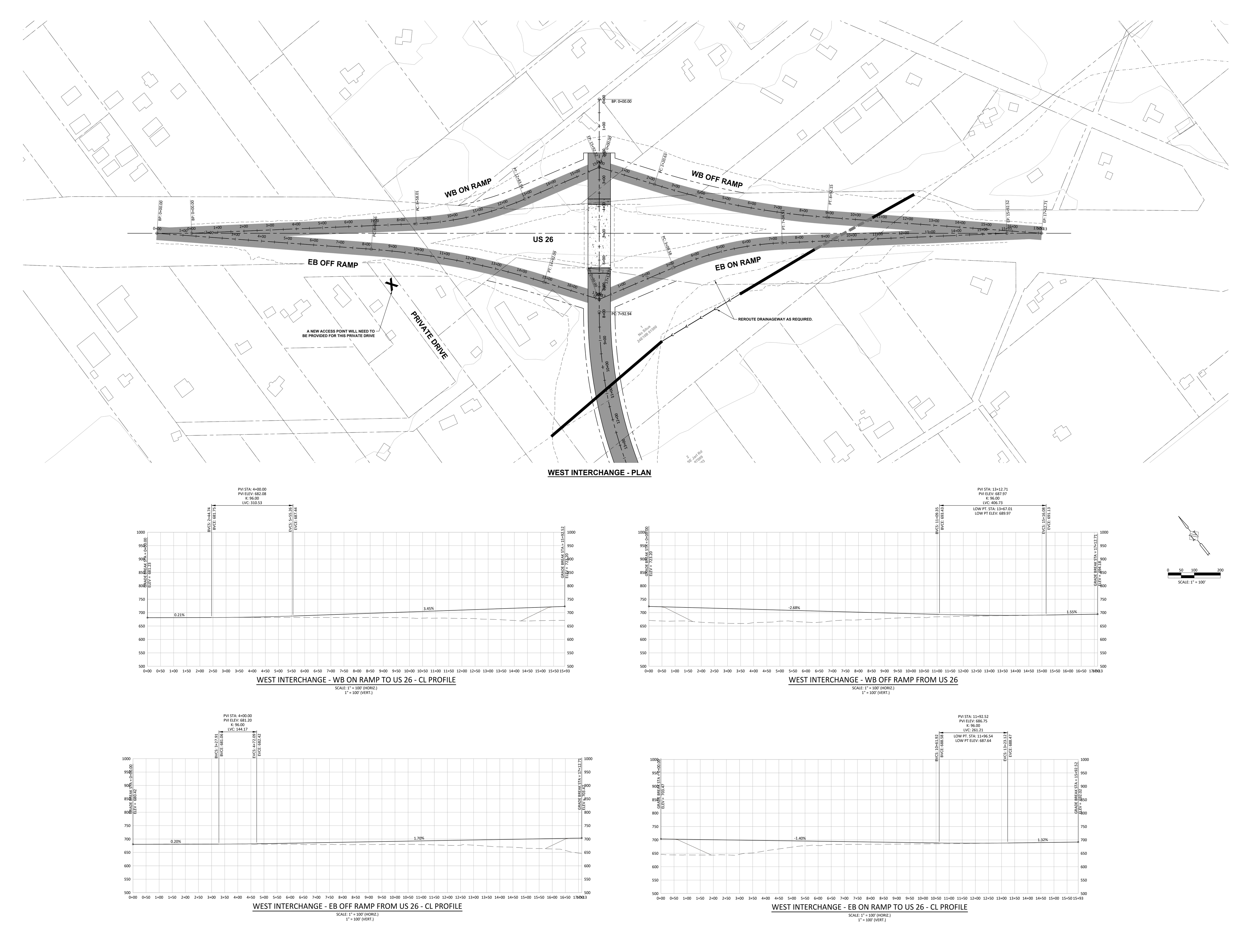
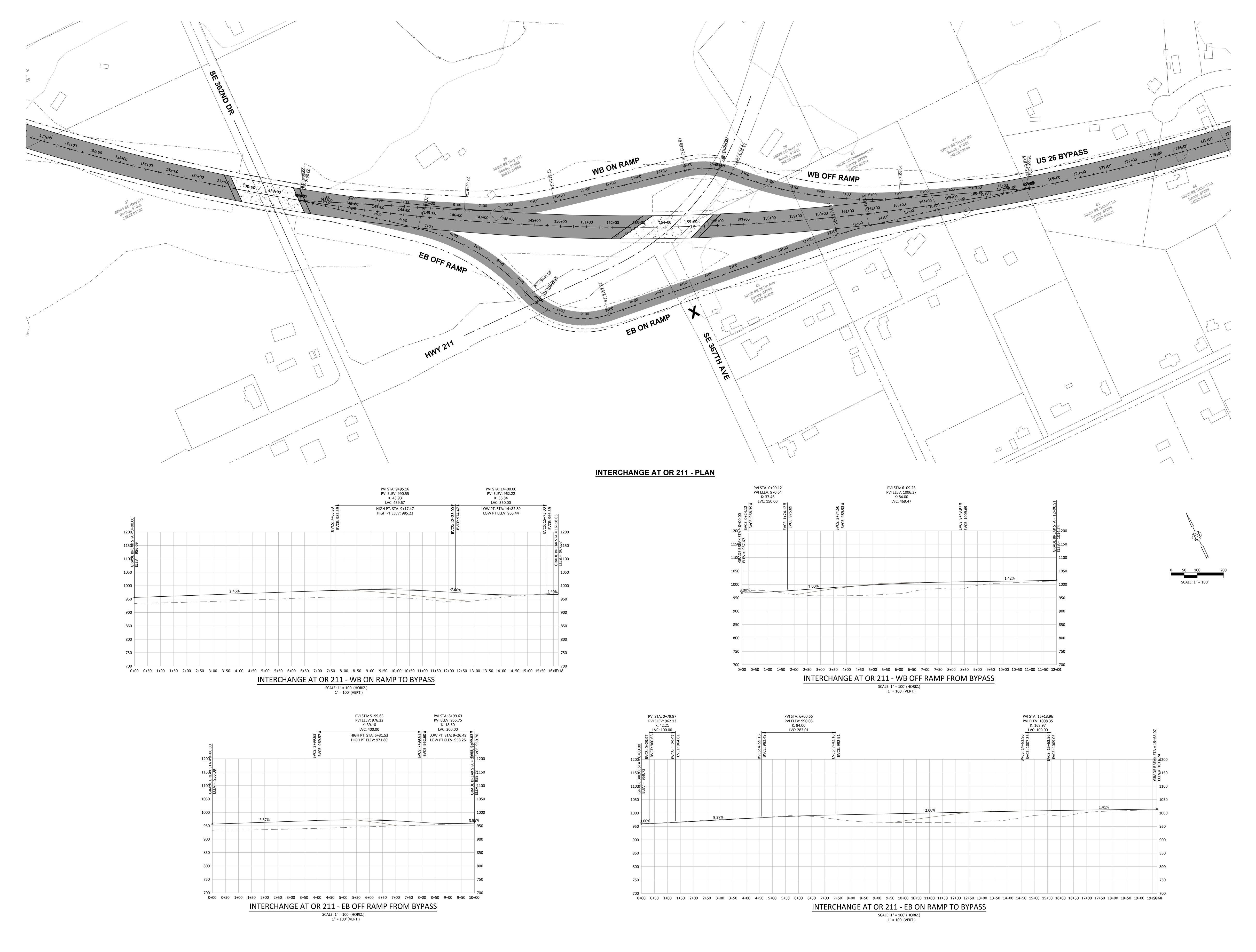
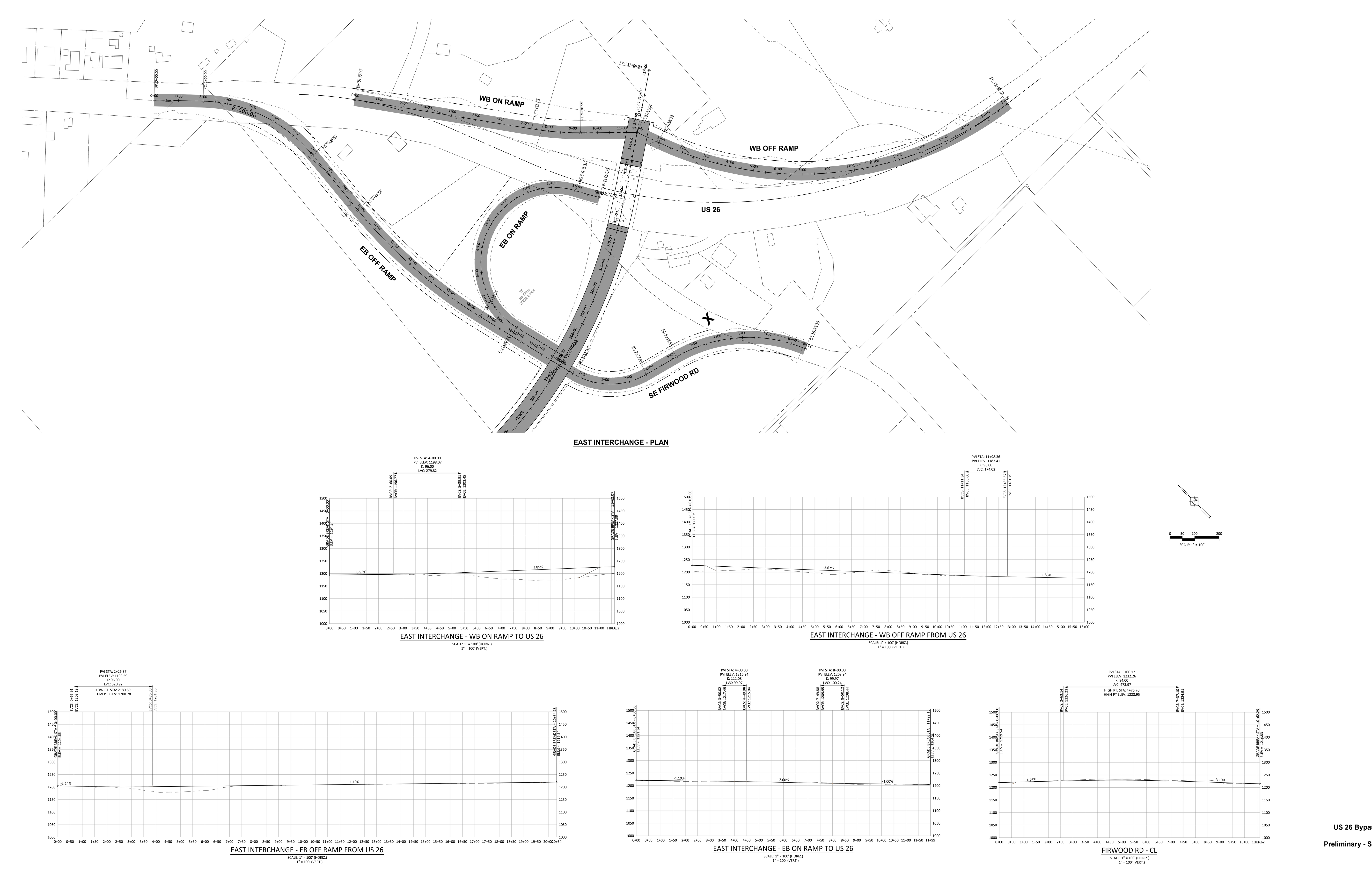
3 of 4







US 26 Bypass - Interchanges
Plans & Profiles
Preliminary - Subject to Change
7/23/2021
DKS-44

SECTION 2. BYPASS COST ESTIMATES

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section

Job No. DKS-44
Date: 7/23/2021

Major Street Segments	Estimated Cost
US 26 Bypass - Freeway Section	$ 224,600,000
Interchange Ramps & SE Firwood Rd Realignment	$ 72,700,000

Overcrossings	Estimated Cost
Overcrossing at West Interchange	$ 16,700,000
Overcrossing at SE 362nd Dr	$ 17,100,000
Overcrossing at OR211 Interchange	$ 17,800,000
Overcrossing at East Interchange	$ 17,300,000

Major Intersections/Structures	Estimated Cost
Private Drive / West Interchange EB Off Ramp	$ 2,000,000
US 26 Bypass / SE Jarl Rd	$ 1,200,000
US 26 Bypass / SE Colorado Rd	$ 1,200,000
US 26 Bypass / SE Gunderson Rd	$ 1,200,000
US 26 Bypass / SE 367th Ave	$ 500,000
US 26 Bypass / SE Seibert Ln	$ 1,000,000
US 26 Bypass / SE Bornstedt Rd	$ 1,000,000
US 26 Bypass / SE Fritsche Ln	$ 500,000
US 26 Bypass / SE Jacoby Rd	$ 1,000,000
US 26 Bypass / SE Langensand Rd	$ 1,200,000

Other	Section Cost
Sanitary Sewer	$ 5,400,000
Waterline	$ 5,700,000

Total Project Development Cost (10%) **$ 388,100,000**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section

Job No. DKS-44
Date: 7/23/2021

Global Cost Assumptions			
Construction Cost Contingency	%	30%	
Contractor LS Incidental	%	15%	(Mob, TPDT, EC, RSO, Staking, etc.)
Capital Project Mgmt. (design & const.)		10.0%	
Design Engineering		10.0%	
Design Survey		1.5%	
Public Involvement		0.5%	
Const. Engineering Support		6.0%	
Inspection		5.0%	

Roadwork			Assumptions
Bridge Structure	SQFT	$ 400.00	
Concrete Curb & Gutter	FOOT	$ 28.00	
Concrete Curb, Std. Type C	FOOT	$ 20.00	
Concrete Curb, Low Profile Mountable	FOOT	$ 25.00	
Concrete Barrier, Permanent	FOOT	$ 75.00	
Sidewalk	SQFT	$ 7.00	
Concrete Median (Paving)	SQFT	$ 20.00	excludes curb
Asphalt Mixture	TON	$ 100.00	
Aggregate Base	CUYD	$ 78.00	
Geotextile Fabric	SQYD	$ 1.00	
Earthwork	CUYD	$ 30.00	
Topsoil	CUYD	$ 45.00	
Bark Mulch (3" depth)	CUYD	$ 90.00	
Groundcovers	SQFT	$ 15.00	At 12" OC spacing, approx. 1/SF
Street Trees	EACH	$ 650.00	
Root Barrier	FOOT	$ 10.00	
Irrigation	SQFT	$ 4.00	
Storm Main (24" dia)	FOOT	$ 240.00	
Storm Lateral (12" dia)	FOOT	$ 115.00	
Storm Manhole (48" dia)	EACH	$ 5,000.00	
Storm Catch Basin	EACH	$ 3,000.00	
Water Quality & Detention	SQFT	$ 20.00	using 6% of imp. Area
Drainageway Crossing, 3 Sided Box Culvert	FOOT	$ 300.00	
Sanitary Main (24" dia)	FOOT	$ 350.00	
Sanitary Main (8" dia)	FOOT	$ 150.00	no laterals - to be installed with development
Sanitary Manhole (60" dia)	EACH	$ 15,000.00	
Sanitary Manhole (48" dia)	EACH	$ 9,000.00	
Water Main (18" DI)	FOOT	$ 225.00	
Water Main (8" DI)	FOOT	$ 110.00	
Fire Hydrants (w/ lat & fittings)	EACH	$ 10,000.00	
Purple Pipe (12" PVC)	FOOT	$ 100.00	
Streetlights (incl conduit)	EACH	$ 4,000.00	
Joint Trench	FOOT	$ 40.00	
Underground Power (vaults)	EACH	$ 15,000.00	
Underground Power (conduit)	FOOT	$ 10.00	

Right-of-Way			
Right-of-Way (SF)	SQFT	$ 10.00	Note: ROW costs are budgetary only and appr
Easement (SF)	SQFT	$ 2.00	Note: ROW costs are budgetary only and appr

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section

Roadway Section Analysis

Job No. DKS-44

Date: 7/23/2021

Major Intersections

Includes extra width for turn lanes, signals, interconnect, ROW, ADA ramps, ped buttons, etc.

Intersection	Private Drive / West Interchange EB Off Ramp	US 26 Bypass / SE Jarl Rd	US 26 Bypass / SE Colorado Rd	US 26 Bypass / SE Gunderson Rd	US 26 Bypass / SE 367th Ave	US 26 Bypass / SE Seibert Ln	US 26 Bypass / SE Bornstedt Rd	US 26 Bypass / SE Fritsche Ln	US 26 Bypass / SE Jacoby Rd	US 26 Bypass / SE Langensand Rd
Construction Cost										
LS Base Cost:	$ 1,000,000	$ 600,000	$ 600,000	$ 600,000	$ 250,000	$ 500,000	$ 500,000	$ 250,000	$ 500,000	$ 600,000
30% Const. Contingency:	$ 300,000	$ 180,000	$ 180,000	$ 180,000	$ 75,000	$ 150,000	$ 150,000	$ 75,000	$ 150,000	$ 180,000
Construction Subtotal:	$ 1,300,000	$ 780,000	$ 780,000	$ 780,000	$ 325,000	$ 650,000	$ 650,000	$ 325,000	$ 650,000	$ 780,000
15% Construction Incidentals:	$ 195,000	$ 117,000	$ 117,000	$ 117,000	$ 48,750	$ 97,500	$ 97,500	$ 48,750	$ 97,500	$ 117,000
Total Construction Cost	**$ 1,495,000**	**$ 897,000**	**$ 897,000**	**$ 897,000**	**$ 373,750**	**$ 747,500**	**$ 747,500**	**$ 373,750**	**$ 747,500**	**$ 897,000**
Professional Services (Design & Construction)										
10% Cap. Proj Mgmt. (des & con)	$ 149,500	$ 89,700	$ 89,700	$ 89,700	$ 37,375	$ 74,750	$ 74,750	$ 37,375	$ 74,750	$ 89,700
10% Design Engineering	$ 149,500	$ 89,700	$ 89,700	$ 89,700	$ 37,375	$ 74,750	$ 74,750	$ 37,375	$ 74,750	$ 89,700
2% Design Survey	$ 22,425	$ 13,455	$ 13,455	$ 13,455	$ 5,606	$ 11,213	$ 11,213	$ 5,606	$ 11,213	$ 13,455
1% Public Involvement	$ 7,475	$ 4,485	$ 4,485	$ 4,485	$ 1,869	$ 3,738	$ 3,738	$ 1,869	$ 3,738	$ 4,485
6% Const. Engineering Support	$ 89,700	$ 53,820	$ 53,820	$ 53,820	$ 22,425	$ 44,850	$ 44,850	$ 22,425	$ 44,850	$ 53,820
5% Inspection	$ 74,750	$ 44,850	$ 44,850	$ 44,850	$ 18,688	$ 37,375	$ 37,375	$ 18,688	$ 37,375	$ 44,850
Total Professional Services	**$ 493,350**	**$ 296,010**	**$ 296,010**	**$ 296,010**	**$ 123,338**	**$ 246,675**	**$ 246,675**	**$ 123,338**	**$ 246,675**	**$ 296,010**
Right-of-Way										
Extra R/W at Intersections										
Total R/W Services	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Intersection Cost	**$ 1,988,350**	**$ 1,193,010**	**$ 1,193,010**	**$ 1,193,010**	**$ 497,088**	**$ 994,175**	**$ 994,175**	**$ 497,088**	**$ 994,175**	**$ 1,193,010**

$300,000 Assumed $300,000 right-in/right-out per side.

$250,000 Will a cul-de-sac be created at each road closure? Assume $250,000 per CDS.

Note: ROW costs are budgetary only and appraisals have not been completed or a value established.

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: US 26 Bypass - Freeway Section

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
freeway section	200	31500	30,323	86.0	2,607,778	120.0	3,638,760	16.0	485,168
			-		-		-		-
			-		-		-		-
			-		-		-		-
			30,323		2,607,778		3,638,760		485,168

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	2,607,778	0.67	64,390	136,506	$ 100.00	$ 13,650,591
Aggregate Base			138,512		$ 78.00	$ 10,803,936
Earthwork					LS	$ 41,066,200

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		30,323	-		$ 20.00	$ -
Planted Median		30,323	-		$ 21.50	$ -
Sidewalk		30,323	-		$ 7.00	$ -
Landscape Strip		30,323	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	373,984	$ 1.00	$ 373,984
W.Q. & Detention			156,467		$ 20.00	$ 3,129,334

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	30,323		-	$ 28.00	$ -
Concrete Curb, Std. Type C	30,323		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	30,323		-	$ 25.00	$ -
Concrete Barrier, Permanent	29,380	1	29,380	$ 75.00	$ 2,203,500
Street Trees	30,323	2	60,646	$ 25.00	$ 1,516,150
Street Lights	30,323	2	60,646	$ 40.00	$ 2,425,840
Storm System	30,323	1	30,323	$ 344.45	$ 10,444,757
Joint Trench + PGE	30,323	1	30,323	$ 117.50	$ 3,562,953
Drainageway Crossing, 3 Sided Box Culvert			2,230	$ 300.00	$ 669,000

		Combined Items Subtotal:	$ 89,846,244
Contingency	30%		$ 26,953,873
		Construction Subtotal:	**$ 116,800,118**
Construction Incidentals	15%		$ 17,520,018
		Total Construction Cost	**$ 134,320,135**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 13,432,014
Design Engineering	10.0%	$ 13,432,014
Design Survey	1.5%	$ 2,014,802
Public Involvement	0.5%	$ 671,601
Const. Engineering Support	6.0%	$ 8,059,208
Inspection	5.0%	$ 6,716,007

Professional Services Total: $ 44,325,645

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	3,638,760		3,638,760		$ 10.00	$ 36,387,600
PUE's	485,168		485,168		$ 2.00	$ 970,336
Permanent Slope Easement	839,279		839,279		$ 2.00	$ 1,678,558
Building Removals	-		-	23	$ 300,000.00	$ 6,900,000

Right-of-Way Subtotal **$ 45,936,494**

Total Project Cost: $ 224,582,274

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Interchange Ramps & SE Firwood Rd Realignment

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
West Interchange Ramps			6,780		210,396		129,844		-
Interchange at OR211			5,787		175,242		437,206		-
East Interchange Ramps			5,995		189,664		602,315		-
SE Firwood Rd			1,062		25,488		72,208		-
			19,624		600,790		1,241,572		-

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	600,790	0.67	14,834	31,449	$ 100.00	$ 3,144,876
Aggregate Base			38,588		$ 78.00	$ 3,009,864
Earthwork					LS	$ 11,305,770

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		19,624	-		$ 20.00	$ -
Planted Median		19,624	-		$ 21.50	$ -
Sidewalk		19,624	-		$ 7.00	$ -
Landscape Strip		19,624	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	121,266	$ 1.00	$ 121,266
W.Q. & Detention			36,047		$ 20.00	$ 720,948

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	19,624		-	$ 28.00	$ -
Concrete Curb, Std. Type C	19,624		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	19,624		-	$ 25.00	$ -
Concrete Barrier, Permanent	19,624		-	$ 75.00	$ -
Street Trees	19,624	2	39,248	$ 25.00	$ 981,200
Street Lights	19,624	2	39,248	$ 40.00	$ 1,569,920
Storm System	19,624	1	19,624	$ 295.00	$ 5,789,080
Joint Trench + PGE	19,624	1	19,624	$ 117.50	$ 2,305,820

		Combined Items Subtotal:	$ 28,948,744
Contingency	30%		$ 8,684,623
		Construction Subtotal:	**$ 37,633,367**
Construction Incidentals	15%		$ 5,645,005
		Total Construction Cost	**$ 43,278,372**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 4,327,837
Design Engineering	10.0%	$ 4,327,837
Design Survey	1.5%	$ 649,176
Public Involvement	0.5%	$ 216,392
Const. Engineering Support	6.0%	$ 2,596,702
Inspection	5.0%	$ 2,163,919
Professional Services Total:		**$ 14,281,863**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	1,241,572		1,241,572		$ 10.00	$ 12,415,724
PUE's	-		-		$ 2.00	$ -
Building Removals	-		-	9	$ 300,000.00	$ 2,700,000

Right-of-Way Subtotal **$ 15,115,724**

Total Project Cost: $ 72,675,959

ODOT Sandy Bypass
Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at West Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at West Interchange			237	86.0	20,382	120.0	28,440		-
									-
									-
									-
			237		20,382		28,440		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	237	20,382		$ 400.00	$ 8,152,800

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Street Lights	237	2	474	$ 40.00	$ 18,960
Storm System	237	1	237	$ 344.45	$ 81,635

		Combined Items Subtotal:	$ 8,253,395
Contingency	30%		$ 2,476,018
		Construction Subtotal:	**$ 10,729,413**
Construction Incidentals	15%		$ 1,609,412
		Total Construction Cost	**$ 12,338,825**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,233,883
Design Engineering	10.0%	$ 1,233,883
Design Survey	1.5%	$ 185,082
Public Involvement	0.5%	$ 61,694
Const. Engineering Support	6.0%	$ 740,330
Inspection	5.0%	$ 616,941
Professional Services Total:		**$ 4,071,812**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	28,440		28,440		$ 10.00	$ 284,400

Right-of-Way Subtotal **$ 284,400**

Total Project Cost: $ 16,695,037

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at SE 362nd Dr

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at SE 362nd Dr			243	86.0	20,898	120.0	29,160		-
									-
									-
									-
			243		20,898		29,160		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	243	20,898		$ 400.00	$ 8,359,200

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length		Unit Price	Total
Street Lights	243	2	486		$ 40.00	$ 19,440
Storm System	243	1	243		$ 344.45	$ 83,701

		Combined Items Subtotal:	$ 8,462,341
Contingency	30%		$ 2,538,702
		Construction Subtotal:	**$ 11,001,044**
Construction Incidentals	15%		$ 1,650,157
		Total Construction Cost	**$ 12,651,200**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,265,120
Design Engineering	10.0%	$ 1,265,120
Design Survey	1.5%	$ 189,768
Public Involvement	0.5%	$ 63,256
Const. Engineering Support	6.0%	$ 759,072
Inspection	5.0%	$ 632,560
	Professional Services Total:	**$ 4,174,896**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	29,160		29,160		$ 10.00	$ 291,600

Right-of-Way Subtotal **$ 291,600**

Total Project Cost: $ 17,117,696

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at OR211 Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at OR211 Interchange			252	86.0	21,672	120.0	30,240		-
									-
									-
									-
			252		21,672		30,240		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	252	21,672		$ 400.00	$ 8,668,800

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length		Unit Price	Total
Street Lights	252	2	504		$ 40.00	$ 20,160
Storm System	252	1	252		$ 344.45	$ 86,801

		Combined Items Subtotal:	$ 8,775,761
Contingency	30%		$ 2,632,728
		Construction Subtotal:	**$ 11,408,490**
Construction Incidentals	15%		$ 1,711,273
		Total Construction Cost	**$ 13,119,763**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,311,976
Design Engineering	10.0%	$ 1,311,976
Design Survey	1.5%	$ 196,796
Public Involvement	0.5%	$ 65,599
Const. Engineering Support	6.0%	$ 787,186
Inspection	5.0%	$ 655,988
	Professional Services Total:	**$ 4,329,522**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	30,240		30,240		$ 10.00	$ 302,400

Right-of-Way Subtotal **$ 302,400**

Total Project Cost: $ 17,751,685

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at East Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at East Interchange			245	86.0	21,070	120.0	29,400		-
									-
									-
									-
			245		21,070		29,400		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	245	21,070		$ 400.00	$ 8,428,000

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Street Lights	245	2	490	$ 40.00	$ 19,600
Storm System	245	1	245	$ 344.45	$ 84,390

		Combined Items Subtotal:	$ 8,531,990
Contingency	30%		$ 2,559,597
		Construction Subtotal:	**$ 11,091,587**
Construction Incidentals	15%		$ 1,663,738
		Total Construction Cost	**$ 12,755,325**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,275,533
Design Engineering	10.0%	$ 1,275,533
Design Survey	1.5%	$ 191,330
Public Involvement	0.5%	$ 63,777
Const. Engineering Support	6.0%	$ 765,320
Inspection	5.0%	$ 637,766
Professional Services Total:		**$ 4,209,257**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	29,400		29,400		$ 10.00	$ 294,000

Right-of-Way Subtotal **$ 294,000**

Total Project Cost: $ 17,258,583

Sanitary System

Unit Prices:	$ 350.00	$ 150.00	$ 15,000.00	$ 9,000.00			
	24" PVC	8" PVC	60" Deep MH	48" MH	Subtotal	Total Cost	
US 26 Bypass	0	31,300	0	79	$ 5,406,000	$ 5,406,000	Note: Used 400' spacing for manholes.
					$ -	$ -	
					$ -	$ -	
Total	-	31,300	-	79			

	Length	Width	Area	Unit Price	Total Cost	
Sanitary Easement	0	20	-	$ 2.00	$ -	Note: ROW costs are budgetary only and

Total Sanitary System **$5,406,000**

Domestic Water System

Unit Prices:

8" Ductile Iron Pipe	$ 110.00	
Hydrants (incl. laterals)	$ 10,000.00	Assume 1 per 500' (roundup)

	8" DI	Hydrants	Subtotal	Fittings (40%)	Total Cost
US 26 Bypass	31,300	63	$ 4,073,000	$ 1,629,200	$ 5,702,200
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
		0	$ -	$ -	$ -

Other Specific Water Items	Length	
XXX		
XXX		
XXX		
XXX		

Total Domestic Water System **$5,702,200**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Section

Job No. DKS-44
Date: 7/23/2021

Major Street Segments	Estimated Cost
US 26 Bypass - Urban Freeway Section	$ 205,900,000
Interchange Ramps & SE Firwood Rd Realignment	$ 72,700,000

Overcrossings	Estimated Cost
Overcrossing at West Interchange	$ 16,700,000
Overcrossing at SE 362nd Dr	$ 17,100,000
Overcrossing at OR211 Interchange	$ 17,800,000
Overcrossing at East Interchange	$ 17,300,000

Major Intersections/Structures	Estimated Cost
Private Drive / West Interchange EB Off Ramp	$ 2,000,000
US 26 Bypass / SE Jarl Rd	$ 1,200,000
US 26 Bypass / SE Colorado Rd	$ 1,200,000
US 26 Bypass / SE Gunderson Rd	$ 1,200,000
US 26 Bypass / SE 367th Ave	$ 500,000
US 26 Bypass / SE Seibert Ln	$ 1,000,000
US 26 Bypass / SE Bornstedt Rd	$ 1,000,000
US 26 Bypass / SE Fritsche Ln	$ 500,000
US 26 Bypass / SE Jacoby Rd	$ 1,000,000
US 26 Bypass / SE Langensand Rd	$ 1,200,000

Other	Section Cost
Sanitary Sewer	$ 5,400,000
Waterline	$ 5,700,000

Total Project Development Cost (10%) **$ 369,400,000**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Sectior

Job No. DKS-44
Date: 7/23/2021

Global Cost Assumptions				
Construction Cost Contingency	%		30%	
Contractor LS Incidental	%		15%	(Mob, TPDT, EC, RSO, Staking, etc.)
Capital Project Mgmt. (design & const.)			10.0%	
Design Engineering			10.0%	
Design Survey			1.5%	
Public Involvement			0.5%	
Const. Engineering Support			6.0%	
Inspection			5.0%	
Roadwork				Assumptions
Bridge Structure	SQFT	$	300.00	
Concrete Curb & Gutter	FOOT	$	28.00	
Concrete Curb, Std. Type C	FOOT	$	20.00	
Concrete Curb, Low Profile Mountable	FOOT	$	25.00	
Concrete Barrier, Permanent	FOOT	$	75.00	
Sidewalk	SQFT	$	7.00	
Concrete Median (Paving)	SQFT	$	20.00	excludes curb
Asphalt Mixture	TON	$	100.00	
Aggregate Base	CUYD	$	78.00	
Geotextile Fabric	SQYD	$	1.00	
Earthwork	CUYD	$	30.00	
Topsoil	CUYD	$	45.00	
Bark Mulch (3" depth)	CUYD	$	90.00	
Groundcovers	SQFT	$	15.00	At 12" OC spacing, approx. 1/SF
Street Trees	EACH	$	650.00	
Root Barrier	FOOT	$	10.00	
Irrigation	SQFT	$	4.00	
Storm Main (24" dia)	FOOT	$	240.00	
Storm Lateral (12" dia)	FOOT	$	115.00	
Storm Manhole (48" dia)	EACH	$	5,000.00	
Storm Catch Basin	EACH	$	3,000.00	
Water Quality & Detention	SQFT	$	20.00	using 6% of imp. Area
Sanitary Main (24" dia)	FOOT	$	350.00	
Sanitary Main (8" dia)	FOOT	$	150.00	no laterals - to be installed with development
Sanitary Manhole (60" dia)	EACH	$	15,000.00	
Sanitary Manhole (48" dia)	EACH	$	9,000.00	
Water Main (18" DI)	FOOT	$	225.00	
Water Main (8" DI)	FOOT	$	110.00	
Fire Hydrants (w/ lat & fittings)	EACH	$	10,000.00	
Purple Pipe (12" PVC)	FOOT	$	100.00	
Streetlights (incl conduit)	EACH	$	4,000.00	
Joint Trench	FOOT	$	40.00	
Underground Power (vaults)	EACH	$	15,000.00	
Underground Power (conduit)	FOOT	$	10.00	
Right-of-Way				
Right-of-Way (SF)	SQFT	$	10.00	Note: ROW costs are budgetary only and appr
Easement (SF)	SQFT	$	2.00	Note: ROW costs are budgetary only and appr

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Section

Roadway Section Analysis

Job No. DKS-44

Date: 7/23/2021

Road Section: US 26 Bypass - Urban Freeway Section

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road Width (ft)	Road Area (sf)	Right of Way Width (ft)	Right of Way Area (sf)	Public Utility Easements Width (ft)	Public Utility Easements Area (sf)
urban freeway section	200	31500	30,323	86.0	2,607,778	100.0	3,032,300	16.0	485,168
			-		-		-		-
			-		-		-		-
			-		-		-		-
			30,323		2,607,778		3,032,300		485,168

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	2,607,778	0.67	64,390	136,506	$ 100.00	$ 13,650,591
Aggregate Base			113,992		$ 78.00	$ 8,891,376
Earthwork					LS	$ 35,681,770

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		30,323	-		$ 20.00	$ -
Planted Median		30,323	-		$ 21.50	$ -
Sidewalk		30,323	-		$ 7.00	$ -
Landscape Strip		30,323	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	347,633	$ 1.00	$ 347,633
W.Q. & Detention			156,467		$ 20.00	$ 3,129,334

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	30,323		-	$ 28.00	$ -
Concrete Curb, Std. Type C	30,323		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	30,323	2	60,646	$ 25.00	$ 1,516,150
Concrete Barrier, Permanent	29,380	1	29,380	$ 75.00	$ 2,203,500
Street Trees	30,323	2	60,646	$ 25.00	$ 1,516,150
Street Lights	30,323	2	60,646	$ 40.00	$ 2,425,840
Storm System	30,323	1	30,323	$ 344.45	$ 10,444,757
Joint Trench + PGE	30,323	1	30,323	$ 117.50	$ 3,562,953
Drainageway Crossing, 3 Sided Box Culvert			2,180	$ 300.00	$ 654,000

		Combined Items Subtotal:	$ 84,024,053
Contingency	30%		$ 25,207,216
		Construction Subtotal:	**$ 109,231,270**
Construction Incidentals	15%		$ 16,384,690
		Total Construction Cost	**$ 125,615,960**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 12,561,596
Design Engineering	10.0%	$ 12,561,596
Design Survey	1.5%	$ 1,884,239
Public Involvement	0.5%	$ 628,080
Const. Engineering Support	6.0%	$ 7,536,958
Inspection	5.0%	$ 6,280,798
	Professional Services Total:	**$ 41,453,267**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	3,032,300		3,032,300		$ 10.00	$ 30,323,000
PUE's	485,168		485,168		$ 2.00	$ 970,336
Permanent Slope Easements	746,353		746,353		$ 2.00	$ 1,492,706
Building Removals	-		-	20	$ 300,000.00	$ 6,000,000

Right-of-Way Subtotal **$ 38,786,042**

Total Project Cost: $ 205,855,269

Sanitary System

Unit Prices:	$ 350.00	$ 150.00	$ 15,000.00	$ 9,000.00			
	24" PVC	8" PVC	60" Deep MH	48" MH	Subtotal	Total Cost	
US 26 Bypass	0	31,300	0	79	$ 5,406,000	$ 5,406,000	Note: Used 400' spacing for manholes.
					$ -	$ -	
					$ -	$ -	
Total	-	31,300	-	79			

	Length	Width	Area	Unit Price	Total Cost	
Sanitary Easement	0	20	-	$ 2.00	$ -	Note: ROW costs are budgetary only and

Total Sanitary System **$5,406,000**

Domestic Water System

Unit Prices:

8" Ductile Iron Pipe	$ 110.00
Hydrants (incl. laterals)	$ 10,000.00

Assume 1 per 500' (roundup)

	8" DI	Hydrants	Subtotal	Fittings (40%)	Total Cost
US 26 Bypass	31,300	63	$ 4,073,000	$ 1,629,200	$ 5,702,200
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
		0	$ -	$ -	$ -

Other Specific Water Items	Length	
XXX		
XXX		
XXX		
XXX		

Total Domestic Water System **$5,702,200**

SECTION 3. FUTURE TRANSPORTATION SYSTEM PERFORMANCE MEMO

FUTURE TRANSPORTATION SYSTEM PERFORMANCE

DATE: June 28, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the future transportation system performance along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the future transportation system performance documents, the expected year 2040 vehicle travel conditions through the City and provides an evaluation of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of future pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan (TSP).

MOTOR VEHICLE CONDITIONS

Future year 2040 operating conditions for vehicles were assessed using data and findings developed for the existing conditions analysis[1] and available growth pattern data for the study area and US 26. The following sections summarize this analysis.

MOTOR VEHICLE ALTERNATIVES

Future improvement alternatives were previously developed and evaluated as part of the 2011 Sandy TSP[2] to enhance connectivity, provide access to developing lands, and address congestion in the US 26 corridor. The objective for each improvement alternative ranged from relying mainly on management and enhancement of the existing transportation system to large investments in new facilities to increase corridor capacity.

Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described in the following sections. Note the prior TSP Alternative #2 – US 26 Widening was not included in this analysis.

[1] Existing Transportation System Performance memo, DKS Associates, April 19, 2021.

[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 NO BUILD ALTERNATIVE

A No Build Alternative would typically be based on the existing system and not include future improvements. However, there are several roadway projects that are fully funded and/or currently in the design phase. It was determined these projects should be included in the No Build Alternative due to the high level of certainty that they will be part of the future system. These projects are listed below. A figure showing the project locations by project ID is provided in the appendix.

- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to 362nd Avenue (portion of #3)
- Extend 362nd Avenue to Bell Street (portion of #4)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Signalized control at the intersection of OR 211 and Dubarko Road and US 26 and Vista Loop Drive (west)/Dubarko extension

2040 ALTERNATIVE #1 – LOCAL SYSTEM ENHANCEMENTS AND MINOR HIGHWAY IMPROVEMENTS

The emphasis of this alternative was to improve overall street connectivity, provide access to lands that would develop in the future, and improve operations on US 26 by enhancing the supporting City street network so that local trips would have less need to travel on US 26.

The future improvement projects included in the 2040 Alternative #1 are listed below. They include roadway and intersection capacity projects. A figure showing the project locations by project ID is provided in the appendix.

Roadway Improvements

- Industrial Way extension to Jarl Road/ US 26 (#1)
- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to Orient Drive (#3)
- Extend 362nd Drive to Kelso Road (#4)
- Extend Kate Schmidt Street from US 26 to the proposed Bell Street extension (#5)
- Extend Industrial Way north of US 26 to Bell Street Extension (#6)
- Extend Olson Road from 362nd Drive to Jewelberry Avenue (#7)
- Extend Agnes Street to Jewelberry Avenue (#8)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Gunderson Road, Sandy Heights St./370th Avenue, Colorado Road, Arletha Court (#10)
- Construct a new road from Dubarko Road to US 26 opposite Vista Loop Drive East (#11)

Intersection Improvements

- US 26/ 362nd Drive - Construct a second westbound left turn lane, receiving lane for second westbound left turn lane, northbound through lane, new southbound leg with through, right turn and left turn lane
- US 26/ Industrial Way – Change southbound approach to dual left turn lanes and a shared through/right lane, construct a northbound left turn lane
- US 26/Ruben Lane - Change southbound approach to dual left turn lanes and a shared through/right lane, change northbound approach to left turn lane, and shared through/right lane
- OR 211/ Proctor Boulevard (US 26) – Construct a northbound left turn lane (restriping only)
- US 26/ Ten Eyck Road/Wolf Drive – Construct a northbound and southbound left turn lane
- US 26/ Vista Loop Drive West – Realign Vista Loop Drive to be perpendicular to US 26
- OR 211/ Dubarko Road - Construct a traffic signal, northbound right turn lane, southbound left turn lane, northbound left turn lane
- OR 211/ Bornstedt Road – Prohibit left turn movements out
- OR 211/ Arletha Court - Realign intersection to create a four-legged intersection with the Gunderson Road extension
- 362nd Drive/ Industrial Way (West) - Construct an eastbound left turn lane with 50 feet of storage
- 362nd Drive/ Dubarko Road - Construct a single-lane roundabout

2040 ALTERNATIVE #3 – LOCAL SYSTEM ENHANCEMENTS AND US 26 BYPASS

Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner. A figure showing the high-level conceptual alignment of the bypass (#13) is provided in the appendix.

For the purpose of this analysis, the bypass concept was assumed to have the following design characteristics:

- Four-lane facility (two lanes in each direction)
- 45 mph posted speed and 50 mph design speed
- Limited access facility
  - interchange at the east and west end connections with US 26
  - at-grade intersection at OR 211 controlled by a traffic signal or roundabout
  - remaining key street intersections limited to right-in/right-out

The bypass conceptual alignment and design characteristics will be further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

MOTOR VEHICLE OPERATIONS

FUTURE FORECASTING

Traffic forecasts for each of the future 2040 alternatives were developed using a combination of available data and prior modeling analysis and findings. The forecasts relied on recent year 2020 intersection counts[3], year 2029 analysis from the 2011 Sandy TSP and ODOT Volume Tables. The forecasts were developed for the TSP study intersections and focused on the peak hour. Future volumes can be found in the operation reports in the appendix.

Future 2040 No Build Alternative forecasts were based on the 2020 count data and growth rates available from the 2029 forecasts. The addition of the Alternative #1 improvements would result in moderate changes to local travel patterns with better connectivity and intersection capacity. The 2040 No Build Alternative forecasts were refined to represent the 2040 Alternative #1 using growth rates available from the 2029 forecasts.

The addition of the bypass would result in significant changes to regional travel patterns. Future 2040 Alternative #3 forecasts were developed using the Alternative #1 volumes, growth rates available from the 2029 forecasts and current travel pattern data.

A travel pattern analysis was completed using StreetLight data which provided information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The data showed the proposed bypass would attract up to 28% of the total US 26 traffic during the peak hour. For a conservative analysis and for alignment with the 2011 Sandy TSP findings, the forecasting assumed 40% of the total US 26 traffic would divert to the bypass.

The 2040 Alternative #1 volumes were adjusted to account for use of the US 26 bypass to develop 2040 Alternative #3 volumes. US 26 is forecasted to serve approximately 3,800 vehicles during the peak hour under the 2040 No Build Alternative. Under the 2040 Alternative #3, US 26 is forecasted to serve approximately 2,300 vehicles and the bypass is forecasted to serve approximately 1,500 vehicles during the peak hour.

JURISDICTIONAL MOBILITY STANDARDS

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better

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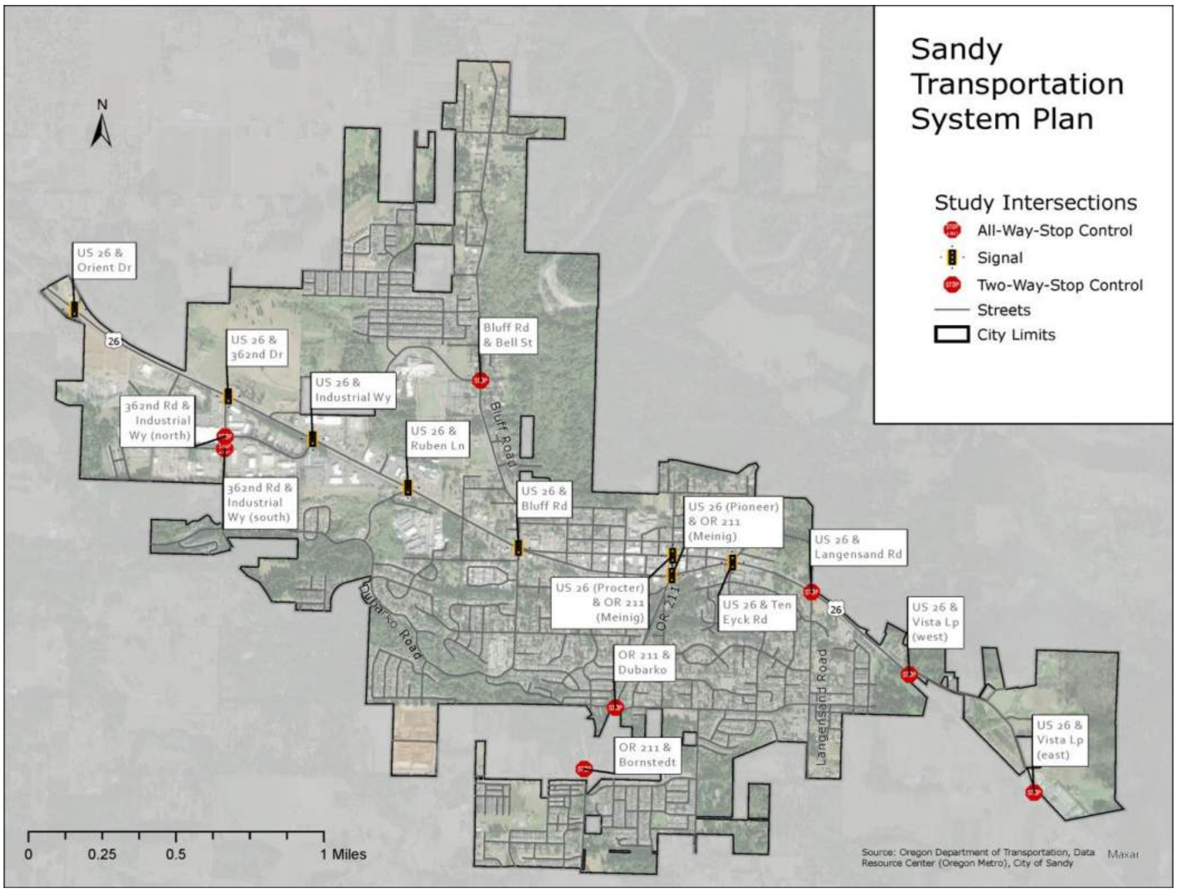
[3] Traffic counts were collected on October 22, 2020.

be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

FUTURE INTERSECTION OPERATIONS

Motor vehicle conditions were evaluated for the 2040 peak hour at the 16 study intersections under each of the future improvement alternatives. The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. The detailed intersection operation reports are shown in the appendix.

FIGURE 1: STUDY INTERSECTIONS WITH EXISTING CONTROL



[4] City of Sandy Transportation System Plan, DKS Associates, 2011.

2040 No Build

As shown in Table 1, eight intersections are forecasted to exceed mobility targets.

- **US 26 and Orient Drive** – The eastbound through movement at this intersection requires more capacity but is limited by the split phasing for Orient Drive/Jarl Road which serves a high southbound left turn volume with only a single approach lane.
- **US 26 and 362nd Drive** – More capacity is needed for the eastbound and westbound left and through movements at this intersection but green time for those movements is limited by the split phasing of the northbound and southbound approaches.
- **US 26 and Industrial Way** – The eastbound through movement and northbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **362nd Drive and Industrial Way (north)** – High northbound and southbound volumes result in limited gaps for the Industrial Way approach at this two-way-stop-controlled intersection.
- **362nd Drive and Industrial Way (south)** – High traffic volumes at all approaches result in long delays for all movements at this all-way-stop-controlled intersection.
- **US 26 and Ruben Lane** - The eastbound through movement and southbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **US 26 and Bluff Road** – The eastbound left and through, westbound left and through, and northbound left movements are all over capacity at this intersection.
- **OR 211 and Bornstedt Road** - High eastbound and westbound volumes result in limited gaps for the Bornstedt Road approach at this two-way-stop-controlled intersection.

TABLE 1: 2040 NO BUILD INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.19**
US 26/362ND DRIVE	Signal	ODOT	0.80	F	121	**1.16**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	E	74	**1.10**
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**B** **[F]**	11 [117]	0.49 [0.94]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	214	1.43
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	35	**0.97**
US 26/BLUFF ROAD	Signal	ODOT	0.85	F	112	**1.12**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	9 [23]	0.29 [0.09]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	30	0.81
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.84
OR 211/ DUBARKO ROAD	Signal	City of Sandy	D	C	21	0.81
OR 211/BORNSTEDT ROAD	TWSC	City of Sandy	D	**A** **[F]**	10 [240]	0.35 [1.32]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	29	0.80
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	16 [>300]	0.48 [0.91]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	C	25	0.66
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [117]	0.48 [0.25]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

2040 Alternative #1

The improvements included in Alternative 1 were analyzed to assess operation benefits at the study intersections resulting from new system network and added capacity. Two intersections that did not meet mobility targets will do so with the improvements in Alternative #1.

- The intersection of US 26 and Industrial Way meets mobility targets with a reduction in demand at the eastbound, westbound and northbound approaches.
- The intersection of OR 211 and Bornstedt Road meets mobility targets with the prohibition of the northbound left turn movement.

Operations under Alternative #1 conditions are show in Table 2. With the new local network connections north of US 26, particularly the Bell Street extension to Orient Drive, through volumes along US 26 are reduced in Alternative #1 which results in improvements to the operation of intersections along the highway.

Six intersections still fail to meet mobility targets under Alternative #1.

- **US 26 and Orient Drive** – There is a higher eastbound left traffic volume and lower eastbound through volume relative to the No Build condition however this reduction does not improve conditions enough for this intersection to meet mobility targets.
- **US 26 and 362nd Drive** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **362nd Drive and Industrial Way (north)** – With an additional southbound through lane that widens this intersection and increased traffic volumes, conditions remain LOS F for the Industrial Way approach.
- **362nd Drive and Industrial Way (south)** – The eastbound left turn lane improves conditions for that approach, but higher northbound and southbound volumes degrade conditions for the major approaches.
- **US 26 and Ruben Lane** - Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **US 26 and Bluff Road** – Lower traffic volumes for the eastbound left and through and westbound through movements improve conditions at this intersection but it still fails to meet mobility targets.

TABLE 2: 2040 ALTERNATIVE #1 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.11**
US 26/362ND DRIVE	Signal	ODOT	0.80	D	41	**1.00**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	D	18	0.79
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**A [F]**	10 [107]	0.46 [1.04]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	>300	1.52
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	D	48	**0.84**
US 26/BLUFF ROAD	Signal	ODOT	0.85	E	73	**0.86**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	8 [16]	0.24 [0.10]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.80
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.72
OR 211/ DUBARKO RD	Signal	City of Sandy	D	B	16	0.68
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	B [B]	11 [15]	0.5 [0.04]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	28	0.73
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	18 [>300]	0.51 [1.21]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	B	17	0.61
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [121]	0.48 [0.26]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

Alternative #3

The improvements included in Alternative 1, combined with the bypass of the existing US 26 corridor, were analyzed to assess operation benefits at the study intersections. Because the impacts on the City street network will vary significantly with the locations and types of access allowed to the bypass, only the US 26 corridor intersections were evaluated to see how much the bypass could relieve congestion.

As shown in Table 3, with the addition of a US 26 bypass only the intersection of US 26 and Orient Drive would exceed mobility targets. The eastbound through and southbound left movements at this intersection continue to compete for available green time in the cycle even with the addition of the bypass.

TABLE 3: 2040 ALTERNATIVE #3 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	32	**0.83**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	34	0.76
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	22	0.56
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	31	0.65
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	42	0.64
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.59
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.67
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	26	0.54
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [D]	10 [33]	0.25 [0.17]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	A	4	0.48
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [F]	10 [62]	0.28 [0.14]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

MOTOR VEHICLE TRAVEL TIME ESTIMATES

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the year 2040 peak hour. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the southern end of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 4 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 4: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:36	09:54
2040 NO BUILD		16:49	14:26
2040 ALTERNATIVE #1		13:18	10:15
2040 ALTERNATIVE #3	US 26 FACILITY	08:54	10:19
	BYPASS FACILITY	07:56	07:56

BYPASS FACILITY CROSS-SECTION CONSIDERATION

The expected 2040 peak hour volumes using the bypass suggest the facility could adequately accommodate demands with a narrower cross-section providing 2 lanes (one in each direction). The highest 2040 volume on the bypass is not expected to exceed 1,000 vehicles in either direction. If the bypass concept was reduced to a 2- lane facility, the connection with OR 211 may require a full interchange instead of an at-grade intersection with traffic signal or roundabout control. The analysis and findings in this future conditions memo would not change since free-flow operations are expected on the bypass with either 2 or 4 lanes and the same future volumes would be served. Both cross-sections options will be considered and further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

SUMMARY

The future conditions findings from this analysis will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- The addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern end of Sandy.
- Compared to the 2040 No Build Alternative, the addition of local connections and intersection improvements under 2040 Alternative #1 would decrease travel times on US 26 approximately 3 minutes 30 seconds eastbound and 4 minutes westbound
- Compared to the 2040 No Build Alternative, the addition of the bypass under 2040 Alternative #3 would decrease travel times on US 26 approximately 8 minutes eastbound and 4 minutes westbound
- Under Alternative #3, the bypass would save travel time through the study area compared to US 26 (1 minute eastbound and 2 minutes 30 seconds westbound)

APPENDIX

CONTENTS

DKS

720 SW WASHINGTON STREET, SUITE 500, PORTLAND, OR 97205 • 503.243.3500 • DKSASSOCIATES.COM

SECTION 1. FUTURE ROADWAY

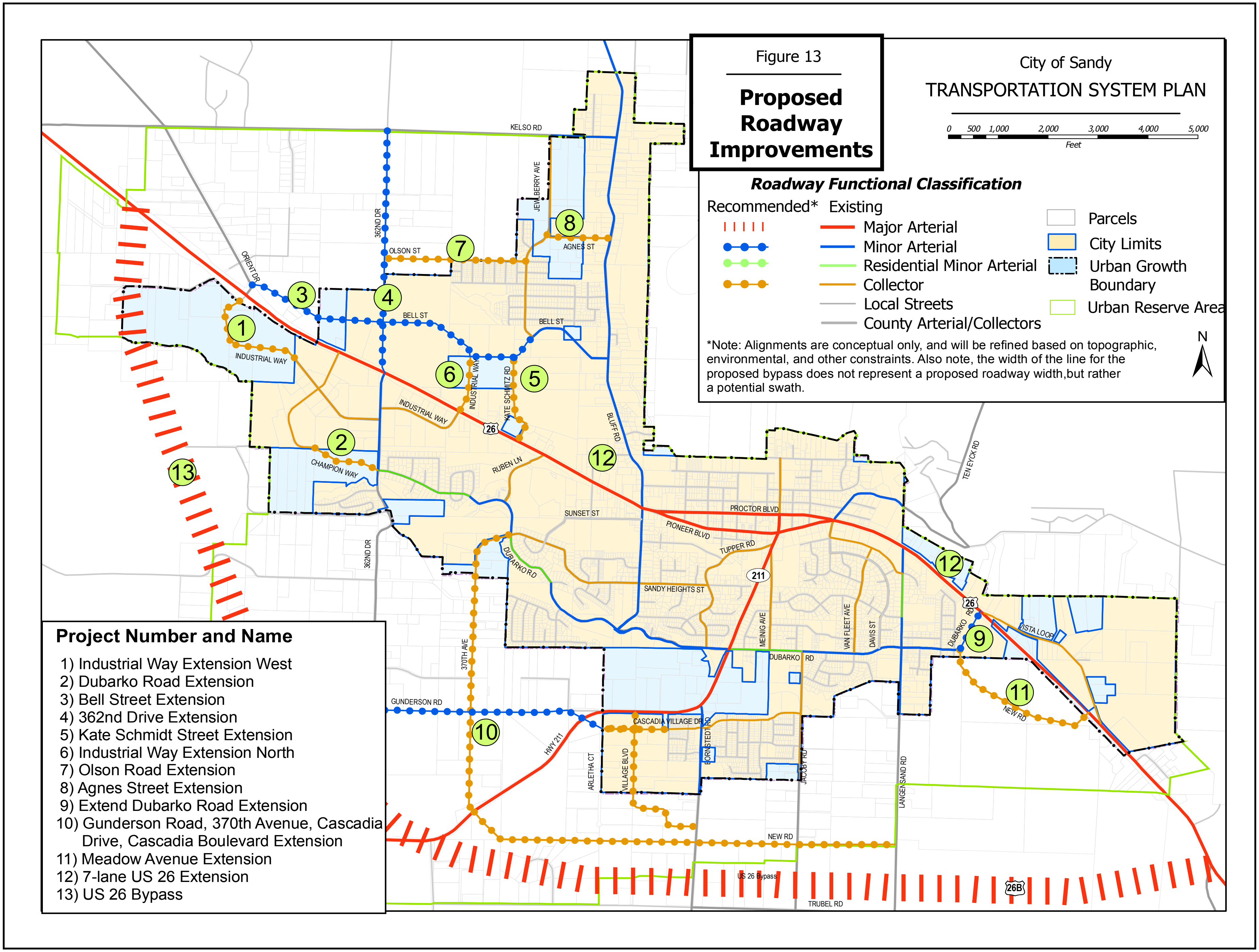


Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
0 500 1,000 2,000 3,000 4,000 5,000
Feet
Roadway Functional Classification
Recommended* Existing
Major Arterial
Minor Arterial
Residential Minor Arterial
Collector
Local Streets
County Arterial/Collectors
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
*Note: Alignments are conceptual only, and will be refined based on topographic, environmental, and other constraints. Also note, the width of the line for the proposed bypass does not represent a proposed roadway width,but rather a potential swath.
N
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
KELSO RD
JEWELBERRY AVE
362ND DR
OLSON ST
AGNES ST
ORIENT DR
BELL ST
INDUSTRIAL WAY
KATE SCHMITZ RD
BLUFF RD
TEN EYCK RD
CHAMPION WAY
RUBEN LN
SUNSET ST
PROCTOR BLVD
PIONEER BLVD
TUPPER RD
DUBARKO RD
SANDY HEIGHTS ST
MEINIG AVE
VAN FLEET AVE
DAVIS ST
VISTA LOOP
370TH AVE
GUNDERSON RD
HWY 211
CASCADIA VILLAGE DR
ARLETHA CT
VILLAGE BLVD
BORNSTEDT RD
JACOBY RD
LANGENSAND RD
NEW RD
US 26 Bypass
TRUBEL RD
26
211
26B

SECTION 2. FUTURE CONDITION HCM REPORTS

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Future Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	63	2653	5	11	1842	0	11	53	11	274	11	21
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	81	1907	850	65	1847		14	69	14	288	12	22
Arrive On Green	0.05	0.57	0.57	0.04	0.56	0.00	0.07	0.06	0.07	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	227	1096	227	1501	60	115
Grp Volume(v), veh/h	63	2653	5	11	1842	0	75	0	0	306	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1551	0	0	1676	0	0
Q Serve(g_s), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Cycle Q Clear(g_c), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.15		0.15	0.90		0.07
Lane Grp Cap(c), veh/h	81	1907	850	65	1847		98	0	0	321	0	0
V/C Ratio(X)	0.78	1.39	0.01	0.17	1.00		0.76	0.00	0.00	0.95	0.00	0.00
Avail Cap(c_a), veh/h	81	1907	850	80	1847		101	0	0	321	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	54.0	24.9	10.8	53.3	25.3	0.0	52.8	0.0	0.0	45.9	0.0	0.0
Incr Delay (d2), s/veh	35.6	179.5	0.0	0.7	20.2	0.0	24.9	0.0	0.0	37.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	69.1	0.1	0.3	26.1	0.0	2.8	0.0	0.0	12.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	89.7	204.4	10.8	54.1	45.5	0.0	77.7	0.0	0.0	83.5	0.0	0.0
LnGrp LOS	F	F	B	D	D		E	A	A	F	A	A
Approach Vol, veh/h		2721			1853	A		75			306	
Approach Delay, s/veh		201.3			45.6			77.7			83.5	
Approach LOS		F			D			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	68.0		26.0	8.5	69.0		11.3
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	5.0	61.0		21.0	5.0	61.0		7.0
Max Q Clear Time (g_c+I1), s	6.2	65.6		22.7	2.7	67.0		7.5
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	133.9
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Future Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
Arrive On Green	0.08	0.37	0.36	0.16	0.56	0.54	0.23	0.23	0.23	0.14	0.14	0.14
Sat Flow, veh/h	1688	3367	1502	1661	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Cycle Q Clear(g_c), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
V/C Ratio(X)	1.59	1.35	0.50	1.08	1.15	0.44	0.46	0.39	1.00	0.67	0.74	0.85
Avail Cap(c_a), veh/h	198	1243	884	258	1397	820	761	402	343	376	395	335
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.20	0.20	0.20	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	41.0	15.6	52.8	28.5	13.2	43.1	42.7	50.2	53.1	53.7	54.6
Incr Delay (d2), s/veh	290.0	165.0	2.0	50.9	68.8	0.3	0.3	0.4	47.8	2.4	3.3	9.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	20.4	47.0	12.5	11.3	30.1	6.0	4.9	4.3	15.5	5.1	6.0	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	327.3	206.0	17.6	103.7	97.4	13.5	43.3	43.0	98.0	55.5	56.9	64.1
LnGrp LOS	F	F	B	F	F	B	D	D	F	E	E	E
Approach Vol, veh/h		2442			2242			853			521	
Approach Delay, s/veh		187.6			84.8			65.2			59.0	
Approach LOS		F			F			E			E	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	21.8	52.0	22.2	15.0	58.8	34.0
Change Period (Y+Rc), s	6.0	* 6	4.0	4.0	6.0	4.5
Max Green Setting (Gmax), s	7.0	* 46	29.0	11.0	42.0	29.5
Max Q Clear Time (g_c+I1), s	17.8	50.0	17.1	13.0	56.8	31.4
Green Ext Time (p_c), s	0.0	0.0	1.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	121.2
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Future Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1620		1624	1638	1508
Flt Permitted	0.06	1.00		0.06	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	100	3316		101	3358	1471		1620		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	66	1985	5	26	1832	51	173	36	255	235	15	173
RTOR Reduction (vph)	0	0	0	0	0	23	0	33	0	0	0	112
Lane Group Flow (vph)	66	1990	0	26	1832	28	0	431	0	125	125	61
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						4
Actuated Green, G (s)	74.3	70.3		71.1	68.7	68.7		22.6		17.3	17.3	17.3
Effective Green, g (s)	75.3	71.7		71.1	70.1	70.1		22.6		17.3	17.3	17.3
Actuated g/C Ratio	0.58	0.55		0.55	0.54	0.54		0.17		0.13	0.13	0.13
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	112	1828		83	1810	793		281		216	217	200
v/s Ratio Prot	c0.02	c0.60		0.01	0.55			c0.27		c0.08	0.08	
v/s Ratio Perm	0.32			0.16		0.02						0.04
v/c Ratio	0.59	1.09		0.31	1.01	0.03		1.53		0.58	0.58	0.31
Uniform Delay, d1	56.5	29.1		59.7	30.0	14.1		53.7		52.9	52.9	50.9
Progression Factor	0.43	0.45		0.79	0.67	2.57		1.00		1.00	1.00	1.00
Incremental Delay, d2	2.8	45.0		0.8	19.5	0.0		257.3		2.8	2.7	0.5
Delay (s)	27.4	58.1		47.8	39.4	36.2		311.0		55.7	55.6	51.4
Level of Service	C	E		D	D	D		F		E	E	D
Approach Delay (s)		57.1			39.5			311.0			53.9	
Approach LOS		E			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	74.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	102.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Future Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1467	1644	3358	1432		1682	1461	1624	1646	1506
Flt Permitted	0.07	1.00	1.00	0.06	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (perm)	132	3318	1467	96	3358	1432		1682	1461	1624	1646	1506
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	177	2066	197	45	1667	101	121	35	40	273	35	136
RTOR Reduction (vph)	0	0	40	0	0	36	0	0	34	0	0	126
Lane Group Flow (vph)	177	2066	157	45	1667	65	0	156	6	153	155	10
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		2	6		6		8	8			4
Actuated Green, G (s)	81.5	80.1	80.1	75.5	75.5	75.5		19.3	19.3	10.0	10.0	10.0
Effective Green, g (s)	81.5	81.5	81.5	75.5	76.9	76.9		19.3	19.3	10.0	10.0	10.0
Actuated g/C Ratio	0.63	0.63	0.63	0.58	0.59	0.59		0.15	0.15	0.08	0.08	0.08
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	175	2080	919	93	1986	847		249	216	124	126	115
v/s Ratio Prot	0.06	c0.62		0.01	c0.50			c0.09		c0.09	0.09	
v/s Ratio Perm	c0.57		0.11	0.27		0.05			0.00			0.01
v/c Ratio	1.01	0.99	0.17	0.48	0.84	0.08		0.63	0.03	1.23	1.23	0.09
Uniform Delay, d1	42.5	24.0	10.1	30.2	21.5	11.4		52.0	47.3	60.0	60.0	55.8
Progression Factor	0.66	0.41	0.29	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.3	4.6	0.0	2.3	4.5	0.2		3.9	0.0	156.7	154.7	0.2
Delay (s)	51.1	14.5	2.9	32.5	26.0	11.5		55.9	47.4	216.7	214.7	56.0
Level of Service	D	B	A	C	C	B		E	D	F	F	E
Approach Delay (s)		16.2			25.4			54.2			166.8	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Future Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	291	1949	158	97	1459	250	148	56	122	158	46	260
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	247	1681	748	75	1150	572	139	78	170	250	53	299
Arrive On Green	0.15	0.50	0.50	0.05	0.39	0.39	0.08	0.16	0.16	0.15	0.23	0.23
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	493	1075	1701	232	1313
Grp Volume(v), veh/h	291	1949	158	97	1459	250	148	0	178	158	0	306
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1569	1701	0	1546
Q Serve(g_s), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Cycle Q Clear(g_c), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.69	1.00		0.85
Lane Grp Cap(c), veh/h	247	1681	748	75	1150	572	139	0	248	250	0	352
V/C Ratio(X)	1.18	1.16	0.21	1.30	1.27	0.44	1.06	0.00	0.72	0.63	0.00	0.87
Avail Cap(c_a), veh/h	247	1681	748	75	1150	572	139	0	428	250	0	422
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.13	0.13	0.13	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	46.9	27.5	15.4	52.5	33.5	24.6	50.5	0.0	43.8	44.1	0.0	40.7
Incr Delay (d2), s/veh	85.1	72.7	0.1	202.2	128.1	2.4	94.2	0.0	2.4	4.4	0.0	14.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.4	37.1	2.2	6.3	35.5	5.2	7.5	0.0	4.8	4.4	0.0	9.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	132.0	100.2	15.5	254.7	161.6	27.0	144.7	0.0	46.2	48.5	0.0	54.9
LnGrp LOS	F	F	B	F	F	C	F	A	D	D	A	D
Approach Vol, veh/h		2398			1806			326			464	
Approach Delay, s/veh		98.5			148.0			90.9			52.7	
Approach LOS		F			F			F			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.0	58.9	13.0	29.1	20.9	47.0	20.7	21.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.5	* 4.5
Max Green Setting (Gmax), s	5.0	49.2	9.0	29.5	12.0	* 43	9.0	* 30
Max Q Clear Time (g_c+I1), s	7.0	56.9	11.0	22.9	18.1	45.0	11.6	13.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.6

Intersection Summary	
HCM 6th Ctrl Delay	111.7
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	100	465	405	5
Future Vol, veh/h	5	55	100	465	405	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	58	105	489	426	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1131	432	433	0	-	0
Stage 1	431	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	223	619	1132	-	-	-
Stage 1	651	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	201	617	1130	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.4	1.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1130	-	201	617	-	-
HCM Lane V/C Ratio	0.093	-	0.026	0.094	-	-
HCM Control Delay (s)	8.5	0	23.4	11.4	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.1	0.3	-	-

Intersection	
Int Delay, s/veh	10.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	80	575	210	190	530
Future Vol, veh/h	55	80	575	210	190	530
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	58	84	605	221	200	558

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1674	718	0	0	826	0
Stage 1	716	-	-	-	-	-
Stage 2	958	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	104	426	-	-	800	-
Stage 1	481	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	78	425	-	-	800	-
Mov Cap-2 Maneuver	78	-	-	-	-	-
Stage 1	481	-	-	-	-	-
Stage 2	277	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	116.9	0	2.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	151	800	-
HCM Lane V/C Ratio	-	-	0.941	0.25	-
HCM Control Delay (s)	-	-	116.9	11	-
HCM Lane LOS	-	-	F	B	-
HCM 95th %tile Q(veh)	-	-	6.8	1	-

Intersection	
Intersection Delay, s/veh	133.5
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	230	125	605	555	30
Future Vol, veh/h	180	230	125	605	555	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	189	242	132	637	584	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	35.2	214.3	101.6
HCM LOS	E	F	F

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	17%	44%	0%
Vol Thru, %	83%	0%	95%
Vol Right, %	0%	56%	5%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	730	410	585
LT Vol	125	180	0
Through Vol	605	0	555
RT Vol	0	230	30
Lane Flow Rate	768	432	616
Geometry Grp	1	1	1
Degree of Util (X)	1.407	0.809	1.116
Departure Headway (Hd)	6.863	7.495	7.139
Convergence, Y/N	Yes	Yes	Yes
Cap	538	488	511
Service Time	4.863	5.495	5.139
HCM Lane V/C Ratio	1.428	0.885	1.205
HCM Control Delay	214.3	35.2	101.6
HCM Lane LOS	F	E	F
HCM 95th-tile Q	34.7	7.6	18.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Future Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				184	1447	16	284	47	0	0	68	42
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				205	1702	20	422	60	0	0	362	224
Arrive On Green				0.56	0.56	0.56	0.35	0.35	0.00	0.00	0.35	0.35
Sat Flow, veh/h				366	3034	35	1018	169	0	0	1022	631
Grp Volume(v), veh/h				861	0	786	331	0	0	0	0	110
Grp Sat Flow(s),veh/h/ln				1712	0	1723	1187	0	0	0	0	1653
Q Serve(g_s), s				48.9	0.0	40.5	24.4	0.0	0.0	0.0	0.0	5.1
Cycle Q Clear(g_c), s				48.9	0.0	40.5	29.4	0.0	0.0	0.0	0.0	5.1
Prop In Lane				0.21		0.02	0.86		0.00	0.00		0.38
Lane Grp Cap(c), veh/h				960	0	967	482	0	0	0	0	586
V/C Ratio(X)				0.90	0.00	0.81	0.69	0.00	0.00	0.00	0.00	0.19
Avail Cap(c_a), veh/h				980	0	987	482	0	0	0	0	586
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.79	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.3	0.0	19.5	34.7	0.0	0.0	0.0	0.0	24.5
Incr Delay (d2), s/veh				12.8	0.0	7.5	6.2	0.0	0.0	0.0	0.0	0.1
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				22.0	0.0	17.5	8.9	0.0	0.0	0.0	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				34.1	0.0	26.9	40.9	0.0	0.0	0.0	0.0	24.7
LnGrp LOS				C	A	C	D	A	A	A	A	C
Approach Vol, veh/h					1647			331			110	
Approach Delay, s/veh					30.7			40.9			24.7	
Approach LOS					C			D			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				43.0		65.7		43.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				39.0		63.0		39.0				
Max Q Clear Time (g_c+I1), s				7.1		50.9		31.4				
Green Ext Time (p_c), s				0.3		10.8		0.9				

Intersection Summary			
HCM 6th Ctrl Delay			32.0
HCM 6th LOS			C

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Future Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1616	0				0	253	258	42	221	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	2082					0	403	334	52	498	0
Arrive On Green	0.63	0.63	0.00				0.00	0.23	0.23	0.01	0.10	0.00
Sat Flow, veh/h	153	3294	1502				0	1772	1470	1647	1730	0
Grp Volume(v), veh/h	908	787	0				0	253	258	42	221	0
Grp Sat Flow(s),veh/h/ln	1764	1683	1502				0	1772	1470	1647	1730	0
Q Serve(g_s), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Cycle Q Clear(g_c), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Prop In Lane	0.09		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1115	1064					0	403	334	52	498	0
V/C Ratio(X)	0.81	0.74					0.00	0.63	0.77	0.81	0.44	0.00
Avail Cap(c_a), veh/h	1115	1064					0	403	334	75	535	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.97	0.97	0.99	0.99	0.00
Uniform Delay (d), s/veh	15.3	14.0	0.0				0.0	38.3	39.8	54.1	41.5	0.0
Incr Delay (d2), s/veh	6.6	4.6	0.0				0.0	7.0	15.4	26.3	0.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	18.1	14.0	0.0				0.0	6.8	7.8	1.6	6.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.9	18.6	0.0				0.0	45.3	55.2	80.4	41.8	0.0
LnGrp LOS	C	B					A	D	E	F	D	A
Approach Vol, veh/h		1695	A					511			263	
Approach Delay, s/veh		20.4						50.3			48.0	
Approach LOS		C						D			D	

Timer - Assigned Phs	2	4	7	8
Phs Duration (G+Y+Rc), s	73.5	36.5	7.5	29.0
Change Period (Y+Rc), s	4.0	* 4.8	4.0	4.8
Max Green Setting (Gmax), s	68.0	* 34	5.0	24.2
Max Q Clear Time (g_c+I1), s	44.9	15.3	4.8	20.1
Green Ext Time (p_c), s	19.7	0.5	0.0	0.7

Intersection Summary	
HCM 6th Ctrl Delay	29.5
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Future Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	179	1526	132	11	1242	26	105	26	11	184	21	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	343	2075	925	24	1398	623	272	64	23	258	24	142
Arrive On Green	0.20	0.62	0.62	0.01	0.43	0.43	0.25	0.26	0.24	0.25	0.26	0.24
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	842	250	92	812	96	558
Grp Volume(v), veh/h	179	1526	132	11	1242	26	142	0	0	331	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1185	0	0	1465	0	0
Q Serve(g_s), s	10.4	35.0	4.1	0.7	39.0	1.1	0.0	0.0	0.0	12.7	0.0	0.0
Cycle Q Clear(g_c), s	10.4	35.0	4.1	0.7	39.0	1.1	11.3	0.0	0.0	24.0	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.74		0.08	0.56		0.38
Lane Grp Cap(c), veh/h	343	2075	925	24	1398	623	354	0	0	418	0	0
V/C Ratio(X)	0.52	0.74	0.14	0.45	0.89	0.04	0.40	0.00	0.00	0.79	0.00	0.00
Avail Cap(c_a), veh/h	343	2075	925	66	1446	645	413	0	0	481	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	39.0	14.8	8.9	53.7	28.8	18.1	34.8	0.0	0.0	39.8	0.0	0.0
Incr Delay (d2), s/veh	1.0	2.4	0.3	7.9	8.8	0.1	0.5	0.0	0.0	7.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	13.4	1.4	0.3	15.8	0.4	3.3	0.0	0.0	9.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	40.0	17.2	9.2	61.7	37.5	18.2	35.3	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	D	B	A	E	D	B	D	A	A	D	A	A
Approach Vol, veh/h		1837			1279			142			331	
Approach Delay, s/veh		18.8			37.4			35.3			47.1	
Approach LOS		B			D			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	72.3		32.1	26.4	51.5		32.1				
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.0	* 61		31.3	15.5	49.2		31.3				
Max Q Clear Time (g_c+I1), s	2.7	37.0		26.0	12.4	41.0		13.3				
Green Ext Time (p_c), s	0.0	19.6		0.5	0.1	6.6		0.4				

Intersection Summary			
HCM 6th Ctrl Delay			28.7
HCM 6th LOS			C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	3.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1535	90	30	1230	25	70
Future Vol, veh/h	1535	90	30	1230	25	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1616	95	32	1295	26	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1711	0	2328	808
Stage 1	-	-	-	-	1616	-
Stage 2	-	-	-	-	712	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	350	-	32	328
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	453	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	350	-	29	328
Mov Cap-2 Maneuver	-	-	-	-	29	-
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	412	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	102.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	29	328	-	-	350	-
HCM Lane V/C Ratio	0.907	0.225	-	-	0.09	-
HCM Control Delay (s)	$ 334.4	19.1	-	-	16.3	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3	0.8	-	-	0.3	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Future Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1723	1723	1716	1716	1723	1723	1723	1800	1723	1800
Adj Flow Rate, veh/h	179	1511	0	105	1200	0	5	5	105	5	0	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	547	2609	1141	436	2509	0	74	0	3	74	0	3
Arrive On Green	0.07	0.78	0.00	0.06	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1460	1641	3346	0	75	75	1569	66	0	1654
Grp Volume(v), veh/h	179	1511	0	105	1200	0	115	0	0	131	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1460	1641	1630	0	1719	0	0	1719	0	0
Q Serve(g_s), s	1.2	9.2	0.0	0.7	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.2	9.2	0.0	0.7	6.8	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.04		0.96
Lane Grp Cap(c), veh/h	547	2609	1141	436	2509	0	77	0	0	77	0	0
V/C Ratio(X)	0.33	0.58	0.00	0.24	0.48	0.00	1.48	0.00	0.00	1.70	0.00	0.00
Avail Cap(c_a), veh/h	888	4942	2160	660	4566	0	855	0	0	851	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	1.8	2.2	0.0	2.2	2.1	0.0	25.4	0.0	0.0	25.4	0.0	0.0
Incr Delay (d2), s/veh	0.3	0.4	0.0	0.2	0.3	0.0	228.6	0.0	0.0	323.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.2	0.0	0.0	0.1	0.0	5.8	0.0	0.0	7.8	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	2.1	2.7	0.0	2.4	2.4	0.0	254.0	0.0	0.0	348.6	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1690			1305			115			131	
Approach Delay, s/veh		2.6			2.4			254.0			348.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	43.0		0.0	7.1	43.6		0.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.0				
Max Green Setting (Gmax), s	14.0	69.0		23.0	10.0	73.0		23.0				
Max Q Clear Time (g_c+I1), s	3.2	8.8		0.0	2.7	11.2		0.0				
Green Ext Time (p_c), s	0.3	17.7		0.0	0.1	26.4		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			25.4									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	0.4					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	1535	1235	25	10	0
Future Vol, veh/h	5	1535	1235	25	10	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	1616	1300	26	11	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1326	0	-	0	2131	663
Stage 1	-	-	-	-	1313	-
Stage 2	-	-	-	-	818	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	517	-	-	-	42	404
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	394	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	517	-	-	-	42	404
Mov Cap-2 Maneuver	-	-	-	-	42	-
Stage 1	-	-	-	-	214	-
Stage 2	-	-	-	-	394	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	117.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	517	-	-	-	42
HCM Lane V/C Ratio	0.01	-	-	-	0.251
HCM Control Delay (s)	12	-	-	-	117.3
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	0.8

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Future Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	32	200	95	168	74	32	116	242	137	53	563	42
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	429	238	113	317	327	141	294	748	631	494	704	594
Arrive On Green	0.03	0.21	0.21	0.10	0.28	0.28	0.06	0.42	0.42	0.04	0.40	0.40
Sat Flow, veh/h	1714	1152	547	1688	1173	507	1688	1772	1495	1674	1758	1482
Grp Volume(v), veh/h	32	0	295	168	0	106	116	242	137	53	563	42
Grp Sat Flow(s),veh/h/ln	1714	0	1700	1688	0	1680	1688	1772	1495	1674	1758	1482
Q Serve(g_s), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Cycle Q Clear(g_c), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Prop In Lane	1.00		0.32	1.00		0.30	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	429	0	351	317	0	468	294	748	631	494	704	594
V/C Ratio(X)	0.07	0.00	0.84	0.53	0.00	0.23	0.39	0.32	0.22	0.11	0.80	0.07
Avail Cap(c_a), veh/h	484	0	524	348	0	617	294	1067	900	530	1058	893
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	25.9	18.3	0.0	18.9	14.3	13.2	12.5	11.8	18.0	12.6
Incr Delay (d2), s/veh	0.1	0.0	6.6	1.0	0.0	0.2	0.6	0.5	0.4	0.1	4.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	5.0	1.9	0.0	1.2	0.9	2.2	1.3	0.4	7.6	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	32.5	19.3	0.0	19.1	14.9	13.7	12.9	11.8	22.8	12.7
LnGrp LOS	C	A	C	B	A	B	B	B	B	B	C	B
Approach Vol, veh/h		327			274			495			658	
Approach Delay, s/veh		31.4			19.2			13.8			21.3	
Approach LOS		C			B			B			C	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	6.5	32.8	10.8	18.1	8.0	31.3	5.8	23.0				
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0				
Max Green Setting (Gmax), s	4.0	40.2	8.0	21.0	4.0	40.2	4.0	25.0				
Max Q Clear Time (g_c+I1), s	3.3	8.2	7.0	13.3	4.8	21.2	3.0	5.3				
Green Ext Time (p_c), s	0.0	3.5	0.0	0.6	0.0	5.3	0.0	0.2				
Intersection Summary												
HCM 6th Ctrl Delay			20.7									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	31					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	400	120	230	570	105	80
Future Vol, veh/h	400	120	230	570	105	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	421	126	242	600	111	84

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	547	0	1568	484
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	1084	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1027	-	123	585
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1027	-	~ 94	585
Mov Cap-2 Maneuver	-	-	-	-	~ 94	-
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	249	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.8	239.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	148	-	-	1027	-
HCM Lane V/C Ratio	1.316	-	-	0.236	-
HCM Control Delay (s)	239.8	-	-	9.6	-
HCM Lane LOS	F	-	-	A	-
HCM 95th %tile Q(veh)	12	-	-	0.9	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Future Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	263	2321	16	11	1511	0	74	53	11	174	11	95
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	182	1735	774	73	1496		65	46	10	207	13	113
Arrive On Green	0.11	0.52	0.52	0.04	0.45	0.00	0.08	0.08	0.08	0.21	0.21	0.21
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	826	591	123	1008	64	550
Grp Volume(v), veh/h	263	2321	16	11	1511	0	138	0	0	280	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1622	0	0
Q Serve(g_s), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Cycle Q Clear(g_c), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.54		0.08	0.62		0.34
Lane Grp Cap(c), veh/h	182	1735	774	73	1496		121	0	0	333	0	0
V/C Ratio(X)	1.44	1.34	0.02	0.15	1.01		1.14	0.00	0.00	0.84	0.00	0.00
Avail Cap(c_a), veh/h	182	1735	774	73	1496		121	0	0	541	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.4	24.7	12.1	46.9	27.9	0.0	46.8	0.0	0.0	38.9	0.0	0.0
Incr Delay (d2), s/veh	227.8	156.2	0.0	0.6	25.8	0.0	124.9	0.0	0.0	6.4	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.9	55.0	0.2	0.3	21.0	0.0	7.3	0.0	0.0	7.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	273.3	180.9	12.1	47.4	53.8	0.0	171.7	0.0	0.0	45.3	0.0	0.0
LnGrp LOS	F	F	B	D	F		F	A	A	D	A	A
Approach Vol, veh/h		2600			1522	A		138			280	
Approach Delay, s/veh		189.2			53.7			171.7			45.3	
Approach LOS		F			D			F			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.0	50.0		24.9	8.5	56.5		12.0				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	10.5	43.0		33.0	4.0	49.5		7.5				
Max Q Clear Time (g_c+I1), s	13.0	48.0		18.9	2.6	54.5		10.0				
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			134.3
HCM 6th LOS			F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Future Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
Arrive On Green	0.07	0.43	0.43	0.29	1.00	1.00	0.23	0.22	0.22	0.06	0.06	0.06
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1511	1688	1772	1502
Grp Volume(v), veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1511	1688	1772	1502
Q Serve(g_s), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Cycle Q Clear(g_c), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
V/C Ratio(X)	0.81	0.98	0.47	0.51	0.86	0.31	0.26	0.70	0.94	0.51	1.45	0.74
Avail Cap(c_a), veh/h	261	1450	1003	463	1725	851	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.51	0.51	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.1	36.5	10.5	42.5	0.0	0.0	41.4	46.5	49.7	59.1	61.0	60.0
Incr Delay (d2), s/veh	16.5	20.0	1.6	0.3	3.2	0.5	0.1	4.5	33.1	2.9	223.6	8.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	24.5	11.9	2.8	0.8	0.1	2.6	8.6	13.1	1.8	10.3	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.5	56.5	12.1	42.8	3.2	0.5	41.5	51.1	82.9	62.0	284.6	68.2
LnGrp LOS	D	E	B	D	A	A	D	D	F	E	F	E
Approach Vol, veh/h		2111			1989			785			279	
Approach Delay, s/veh		45.5			7.6			61.5			189.6	
Approach LOS		D			A			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	24.7	60.0		12.0	13.0	71.7		33.4				
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5				
Max Green Setting (Gmax), s	10.0	* 54		18.0	9.0	55.0		29.5				
Max Q Clear Time (g_c+I1), s	11.0	56.4		7.8	11.0	2.0		28.7				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	51.5		0.1				

Intersection Summary			
HCM 6th Ctrl Delay			41.1
HCM 6th LOS			D

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Future Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3315		1644	3358	1471	1693	1569		3317	1580	
Flt Permitted	0.08	1.00		0.06	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	140	3315		102	3358	1471	1693	1569		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1679	10	41	1628	51	173	26	102	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	20	0	91	0	0	71	0
Lane Group Flow (vph)	51	1689	0	41	1628	31	173	37	0	224	113	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	82.0	78.8		82.0	78.8	78.8	13.5	13.5		17.1	17.1	
Effective Green, g (s)	83.0	80.2		82.0	80.2	80.2	14.5	13.5		17.1	17.1	
Actuated g/C Ratio	0.64	0.62		0.63	0.62	0.62	0.11	0.10		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	133	2045		102	2071	907	188	162		436	207	
v/s Ratio Prot	c0.01	c0.51		0.01	0.48		c0.10	0.02		0.07	c0.07	
v/s Ratio Perm	0.23			0.24		0.02						
v/c Ratio	0.38	0.83		0.40	0.79	0.03	0.92	0.23		0.51	0.54	
Uniform Delay, d1	35.2	19.4		40.6	18.5	9.7	57.2	53.5		52.6	52.8	
Progression Factor	0.38	0.21		0.47	0.46	0.50	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.4		1.0	2.1	0.0	43.5	0.7		0.6	2.0	
Delay (s)	14.1	6.4		20.1	10.6	4.9	100.7	54.2		53.2	54.8	
Level of Service	B	A		C	B	A	F	D		D	D	
Approach Delay (s)		6.6			10.7			80.9			53.9	
Approach LOS		A			B			F			D	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
5: Ruben Lane & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱		↰↰	↱	
Traffic Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Future Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	126	1641	0	56	1465	96	116	81	35	212	56	167
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	420	2226		232	1638	713	184	118	51	256	30	90
Arrive On Green	0.41	1.00	0.00	0.03	0.48	0.48	0.11	0.10	0.10	0.08	0.08	0.08
Sat Flow, veh/h	1688	3331	1502	1661	3383	1473	1674	1160	501	3326	393	1173
Grp Volume(v), veh/h	126	1641	0	56	1465	96	116	0	116	212	0	223
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1473	1674	0	1661	1663	0	1567
Q Serve(g_s), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.75
Lane Grp Cap(c), veh/h	420	2226		232	1638	713	184	0	169	256	0	121
V/C Ratio(X)	0.30	0.74		0.24	0.89	0.13	0.63	0.00	0.69	0.83	0.00	1.85
Avail Cap(c_a), veh/h	420	2226		234	1639	714	476	0	460	256	0	121
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.53	0.53	0.00	0.46	0.46	0.46	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	0.0	0.0	19.8	30.5	18.5	55.4	0.0	56.4	59.2	0.0	60.0
Incr Delay (d2), s/veh	0.1	1.2	0.0	0.1	4.0	0.2	2.2	0.0	3.0	19.2	0.0	412.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.4	0.0	0.9	20.7	1.6	3.8	0.0	3.9	4.2	0.0	17.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.2	1.2	0.0	19.9	34.5	18.7	57.6	0.0	59.3	78.3	0.0	472.7
LnGrp LOS	C	A		B	C	B	E	A	E	E	A	F
Approach Vol, veh/h		1767	A		1617			232			435	
Approach Delay, s/veh		3.3			33.0			58.5			280.5	
Approach LOS		A			C			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.9	90.9		14.0	31.8	66.9		17.3				
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0				
Max Green Setting (Gmax), s	4.0	* 63		10.0	* 5	* 62		36.0				
Max Q Clear Time (g_c+I1), s	4.5	2.0		12.0	2.0	53.2		10.8				
Green Ext Time (p_c), s	0.0	59.0		0.0	0.1	8.3		0.8				

Intersection Summary		
HCM 6th Ctrl Delay		48.1
HCM 6th LOS		D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Future Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	82	1673	184	71	1398	301	92	5	26	270	148	87
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	127	1408	626	375	1675	834	115	30	155	216	191	112
Arrive On Green	0.04	0.42	0.42	0.19	0.57	0.57	0.07	0.12	0.13	0.13	0.18	0.19
Sat Flow, veh/h	1688	3367	1498	1647	2941	1465	1701	245	1275	1701	1053	619
Grp Volume(v), veh/h	82	1673	184	71	1398	301	92	0	31	270	0	235
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1465	1701	0	1520	1701	0	1672
Q Serve(g_s), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Cycle Q Clear(g_c), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.84	1.00		0.37
Lane Grp Cap(c), veh/h	127	1408	626	375	1675	834	115	0	185	216	0	303
V/C Ratio(X)	0.65	1.19	0.29	0.19	0.83	0.36	0.80	0.00	0.17	1.25	0.00	0.78
Avail Cap(c_a), veh/h	127	1408	626	375	1675	834	186	0	414	216	0	486
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.55	0.55	0.55	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.3	32.0	11.4	36.3	19.4	12.8	50.6	0.0	43.1	48.0	0.0	42.8
Incr Delay (d2), s/veh	5.3	89.0	0.7	0.1	5.1	1.2	7.7	0.0	0.3	143.7	0.0	2.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	34.9	2.3	1.6	15.2	4.2	2.8	0.0	0.8	14.6	0.0	6.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	33.6	121.0	12.1	36.4	24.5	14.0	58.2	0.0	43.4	191.7	0.0	45.4
LnGrp LOS	C	F	B	D	C	B	E	A	D	F	A	D
Approach Vol, veh/h		1939			1770			123			505	
Approach Delay, s/veh		106.9			23.2			54.5			123.7	
Approach LOS		F			C			D			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.6	50.0	11.4	23.9	8.0	66.6	18.0	17.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	45.2	12.0	31.5	4.0	46.0	14.0	29.5
Max Q Clear Time (g_c+I1), s	12.0	48.0	7.9	16.7	5.4	44.9	16.0	4.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	1.1	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	73.2
HCM 6th LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	60	15	395	380	5
Future Vol, veh/h	5	60	15	395	380	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	63	16	416	400	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	854	406	407	0	-	0
Stage 1	405	-	-	-	-	-
Stage 2	449	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	326	641	1157	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	320	639	1155	-	-	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	658	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1155	-	320	639	-	-
HCM Lane V/C Ratio	0.014	-	0.016	0.099	-	-
HCM Control Delay (s)	8.2	0	16.4	11.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.3	-	-

Intersection	
Int Delay, s/veh	17

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	185	85	505	245	15	670
Future Vol, veh/h	185	85	505	245	15	670
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	195	89	532	258	16	705

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1046	663	0	0	790	0
Stage 1	661	-	-	-	-	-
Stage 2	385	-	-	-	-	-
Critical Hdwy	6.66	6.26	-	-	4.145	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.86	-	-	-	-	-
Follow-up Hdwy	3.538	3.338	-	-	2.2285	-
Pot Cap-1 Maneuver	235	456	-	-	822	-
Stage 1	508	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	231	455	-	-	822	-
Mov Cap-2 Maneuver	231	-	-	-	-	-
Stage 1	508	-	-	-	-	-
Stage 2	641	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	106.6	0	0.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	273	822	-
HCM Lane V/C Ratio	-	-	1.041	0.019	-
HCM Control Delay (s)	-	-	106.6	9.5	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	11	0.1	-

Intersection	
Intersection Delay, s/veh	221.9
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	255	65	650	850	5
Future Vol, veh/h	100	255	65	650	850	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	105	268	68	684	895	5
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	18.1	203.4	322
HCM LOS	C	F	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	9%	100%	0%	0%	0%
Vol Thru, %	91%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	715	100	255	850	5
LT Vol	65	100	0	0	0
Through Vol	650	0	0	850	0
RT Vol	0	0	255	0	5
Lane Flow Rate	753	105	268	895	5
Geometry Grp	4	7	7	7	7
Degree of Util (X)	1.376	0.237	0.514	1.66	0.009
Departure Headway (Hd)	7.422	9.469	8.203	7.144	6.423
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	497	382	443	519	561
Service Time	5.422	7.169	5.903	4.844	4.123
HCM Lane V/C Ratio	1.515	0.275	0.605	1.724	0.009
HCM Control Delay	203.4	15.1	19.3	323.8	9.2
HCM Lane LOS	F	C	C	F	A
HCM 95th-tile Q	30.9	0.9	2.9	48.1	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Future Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				58	1463	16	263	53	0	0	105	26
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				68	1811	21	441	612	0	0	473	117
Arrive On Green				0.55	0.55	0.55	0.58	0.58	0.00	0.00	0.35	0.35
Sat Flow, veh/h				124	3284	38	1289	1772	0	0	1369	339
Grp Volume(v), veh/h				805	0	732	263	53	0	0	0	131
Grp Sat Flow(s),veh/h/ln				1724	0	1723	1289	1772	0	0	0	1708
Q Serve(g_s), s				43.2	0.0	36.5	17.5	1.5	0.0	0.0	0.0	6.0
Cycle Q Clear(g_c), s				43.2	0.0	36.5	23.5	1.5	0.0	0.0	0.0	6.0
Prop In Lane				0.07		0.02	1.00		0.00	0.00		0.20
Lane Grp Cap(c), veh/h				950	0	950	441	612	0	0	0	590
V/C Ratio(X)				0.85	0.00	0.77	0.60	0.09	0.00	0.00	0.00	0.22
Avail Cap(c_a), veh/h				1003	0	1002	441	612	0	0	0	590
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.87	0.87	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				20.8	0.0	19.3	22.5	15.5	0.0	0.0	0.0	25.5
Incr Delay (d2), s/veh				9.2	0.0	6.0	5.1	0.2	0.0	0.0	0.0	0.1
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				19.1	0.0	15.7	5.1	0.6	0.0	0.0	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				30.0	0.0	25.3	27.6	15.8	0.0	0.0	0.0	25.7
LnGrp LOS				C	A	C	C	B	A	A	A	C
Approach Vol, veh/h					1537			316			131	
Approach Delay, s/veh					27.7			25.7			25.7	
Approach LOS					C			C			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				42.0		64.7		42.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				38.0		64.0		38.0				
Max Q Clear Time (g_c+I1), s				8.0		45.2		25.5				
Green Ext Time (p_c), s				0.4		15.4		1.1				
Intersection Summary												
HCM 6th Ctrl Delay			27.3									
HCM 6th LOS			C									

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Future Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	84	1389	0				0	237	311	89	74	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	107	1853					0	451	375	111	620	0
Arrive On Green	0.57	0.57	0.00				0.00	0.25	0.25	0.02	0.12	0.00
Sat Flow, veh/h	188	3258	1502				0	1772	1473	1647	1730	0
Grp Volume(v), veh/h	789	684	0				0	237	311	89	74	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1473	1647	1730	0
Q Serve(g_s), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Cycle Q Clear(g_c), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Prop In Lane	0.11		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1002	957					0	451	375	111	620	0
V/C Ratio(X)	0.79	0.71					0.00	0.53	0.83	0.80	0.12	0.00
Avail Cap(c_a), veh/h	1002	957					0	451	375	165	676	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.93	0.93	0.98	0.98	0.00
Uniform Delay (d), s/veh	18.5	17.2	0.0				0.0	35.3	38.7	53.0	33.0	0.0
Incr Delay (d2), s/veh	6.2	4.6	0.0				0.0	4.0	17.6	11.3	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.7	13.3	0.0				0.0	5.8	9.5	2.9	1.8	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.7	21.8	0.0				0.0	39.3	56.4	64.3	33.0	0.0
LnGrp LOS	C	C					A	D	E	E	C	A
Approach Vol, veh/h		1473	A					548			163	
Approach Delay, s/veh		23.4						49.0			50.1	
Approach LOS		C						D			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		66.6		43.4			11.4	32.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		59.0		43.0			11.0	27.2				
Max Q Clear Time (g_c+I1), s		40.4		6.2			7.9	23.9				
Green Ext Time (p_c), s		14.8		0.2			0.0	0.7				

Intersection Summary			
HCM 6th Ctrl Delay			31.8
HCM 6th LOS			C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Future Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	163	1437	137	11	1237	21	95	26	11	142	21	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	366	1887	841	192	1494	666	193	254	108	331	38	283
Arrive On Green	0.22	0.56	0.56	0.12	0.46	0.46	0.21	0.21	0.20	0.21	0.21	0.20
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	163	1437	137	11	1237	21	95	0	37	142	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.2	36.0	4.9	0.7	36.7	0.9	8.1	0.0	1.9	10.1	0.0	11.7
Cycle Q Clear(g_c), s	9.2	36.0	4.9	0.7	36.7	0.9	19.8	0.0	1.9	12.0	0.0	11.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	366	1887	841	192	1494	666	193	0	362	331	0	321
V/C Ratio(X)	0.44	0.76	0.16	0.06	0.83	0.03	0.49	0.00	0.10	0.43	0.00	0.56
Avail Cap(c_a), veh/h	366	2121	945	192	1640	732	203	0	376	342	0	334
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.3	18.5	11.7	43.0	25.8	16.1	48.1	0.0	35.1	40.2	0.0	39.4
Incr Delay (d2), s/veh	0.5	3.0	0.4	0.1	5.4	0.1	1.5	0.0	0.1	0.7	0.0	1.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	14.3	1.7	0.3	14.3	0.3	2.6	0.0	0.8	3.5	0.0	4.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.8	21.5	12.1	43.1	31.2	16.2	49.5	0.0	35.2	40.9	0.0	40.9
LnGrp LOS	D	C	B	D	C	B	D	A	D	D	A	D
Approach Vol, veh/h		1737			1269			132			321	
Approach Delay, s/veh		22.3			31.0			45.5			40.9	
Approach LOS		C			C			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	17.1	65.7		27.3	27.9	54.8		27.3				
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.0	69.3		22.7	17.5	55.8		22.7				
Max Q Clear Time (g_c+I1), s	12.7	38.0		14.0	11.2	38.7		21.8				
Green Ext Time (p_c), s	0.0	23.7		0.7	0.2	12.2		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		28.1
HCM 6th LOS		C

Intersection						
Int Delay, s/veh	5.3					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Traffic Vol, veh/h	1390	100	110	1220	25	85
Future Vol, veh/h	1390	100	110	1220	25	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1463	105	116	1284	26	89

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1568	0	2337	732
Stage 1	-	-	-	-	1463	-
Stage 2	-	-	-	-	874	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	398	-	32	368
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	373	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	398	-	~ 23	368
Mov Cap-2 Maneuver	-	-	-	-	~ 23	-
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	264	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	122.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	23	368	-	-	398	-
HCM Lane V/C Ratio	1.144	0.243	-	-	0.291	-
HCM Control Delay (s)	$ 479.7	17.9	-	-	17.7	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3.4	0.9	-	-	1.2	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary
17: Dubarko Ext/Vista Loop West & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Future Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	137	1421	5	106	1305	0	5	5	105	5	0	105
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	177	2488	1119	136	2347	0	82	0	4	82	0	4
Arrive On Green	0.11	0.75	0.75	0.08	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3346	0	77	77	1614	78	0	1641
Grp Volume(v), veh/h	137	1421	5	106	1305	0	115	0	0	110	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	0	1768	0	0	1719	0	0
Q Serve(g_s), s	3.7	8.7	0.0	2.8	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.7	8.7	0.0	2.8	8.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.05		0.95
Lane Grp Cap(c), veh/h	177	2488	1119	136	2347	0	86	0	0	86	0	0
V/C Ratio(X)	0.77	0.57	0.00	0.78	0.56	0.00	1.34	0.00	0.00	1.28	0.00	0.00
Avail Cap(c_a), veh/h	656	5089	2288	551	4754	0	969	0	0	938	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	20.0	2.6	1.5	20.7	3.0	0.0	23.0	0.0	0.0	23.0	0.0	0.0
Incr Delay (d2), s/veh	5.3	0.4	0.0	6.9	0.4	0.0	166.7	0.0	0.0	141.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.2	0.0	1.1	0.1	0.0	4.8	0.0	0.0	4.2	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.3	3.0	1.5	27.6	3.4	0.0	189.7	0.0	0.0	164.6	0.0	0.0
LnGrp LOS	C	A	A	C	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1563			1411			115			110	
Approach Delay, s/veh		5.0			5.3			189.7			164.6	
Approach LOS		A			A			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.9	37.1		0.0	7.7	38.2		0.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	18.0	67.0		23.0	15.0	70.0		23.0
Max Q Clear Time (g_c+I1), s	5.7	10.6		0.0	4.8	10.7		0.0
Green Ext Time (p_c), s	0.2	20.0		0.0	0.2	23.6		0.0

Intersection Summary			
HCM 6th Ctrl Delay			17.2
HCM 6th LOS			B

Intersection	
Int Delay, s/veh	21.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Future Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	1526	5	105	1405	26	5	5	105	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1431	0	0	1531	0	0	2449	3177	763	2404	-	-
Stage 1	-	-	-	-	-	-	1536	1536	-	1628	-	-
Stage 2	-	-	-	-	-	-	913	1641	-	776	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	471	-	-	431	-	-	16	10	347	17	0	0
Stage 1	-	-	-	-	-	-	121	176	-	106	0	0
Stage 2	-	-	-	-	-	-	294	156	-	356	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	471	-	-	431	-	-	13	7	347	~ 4	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	7	-	~ 4	-	-
Stage 1	-	-	-	-	-	-	120	174	-	105	-	-
Stage 2	-	-	-	-	-	-	222	118	-	238	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	1.1	$ 357.9	$ 2367.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	79	471	-	-	431	-	-	4
HCM Lane V/C Ratio	1.466	0.011	-	-	0.244	-	-	2.632
HCM Control Delay (s)	$ 357.9	12.7	-	-	16	-	$ 2367.8	
HCM Lane LOS	F	B	-	-	C	-	-	F
HCM 95th %tile Q(veh)	9.3	0	-	-	0.9	-	-	2.4

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Future Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	42	32	142	253	111	32	32	316	437	11	495	16
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	378	43	193	436	355	102	302	728	614	337	693	584
Arrive On Green	0.03	0.15	0.15	0.15	0.27	0.27	0.03	0.41	0.41	0.01	0.39	0.39
Sat Flow, veh/h	1714	288	1277	1688	1322	381	1688	1772	1494	1674	1758	1482
Grp Volume(v), veh/h	42	0	174	253	0	143	32	316	437	11	495	16
Grp Sat Flow(s),veh/h/ln	1714	0	1565	1688	0	1703	1688	1772	1494	1674	1758	1482
Q Serve(g_s), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Cycle Q Clear(g_c), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Prop In Lane	1.00		0.82	1.00		0.22	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	378	0	236	436	0	458	302	728	614	337	693	584
V/C Ratio(X)	0.11	0.00	0.74	0.58	0.00	0.31	0.11	0.43	0.71	0.03	0.71	0.03
Avail Cap(c_a), veh/h	438	0	565	499	0	820	371	1158	977	434	1149	969
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.8	0.0	23.6	15.7	0.0	17.0	12.1	12.3	14.3	11.2	14.8	10.8
Incr Delay (d2), s/veh	0.1	0.0	3.3	1.0	0.0	0.3	0.1	0.9	3.3	0.0	2.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	2.3	2.4	0.0	1.4	0.2	2.5	4.6	0.1	5.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.9	0.0	26.9	16.7	0.0	17.3	12.2	13.1	17.5	11.2	17.8	10.8
LnGrp LOS	B	A	C	B	A	B	B	B	B	B	B	B
Approach Vol, veh/h		216			396			785			522	
Approach Delay, s/veh		25.5			16.9			15.5			17.4	
Approach LOS		C			B			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	4.7	27.9	12.8	12.8	5.6	26.9	6.0	19.6
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	37.2	11.0	21.0	4.0	37.2	4.0	28.0
Max Q Clear Time (g_c+I1), s	2.2	16.2	8.8	8.2	2.7	15.8	3.2	5.9
Green Ext Time (p_c), s	0.0	6.9	0.2	0.4	0.0	4.5	0.0	0.4

Intersection Summary	
HCM 6th Ctrl Delay	17.5
HCM 6th LOS	B

Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	60	210	615	0	15
Future Vol, veh/h	740	60	210	615	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	779	63	221	647	0	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	842	0	-	811
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.11	-	-	6.21
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.209	-	-	3.309
Pot Cap-1 Maneuver	-	-	798	-	0	381
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	798	-	-	381
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	14.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	381	-	-	798	-
HCM Lane V/C Ratio	0.041	-	-	0.277	-
HCM Control Delay (s)	14.9	-	-	11.2	-
HCM Lane LOS	B	-	-	B	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	-

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Future Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	105	1605	5	5	784	0	26	42	11	258	21	32
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	145	1750	780	73	1583		32	52	14	303	25	38
Arrive On Green	0.09	0.52	0.52	0.04	0.48	0.00	0.07	0.06	0.07	0.22	0.22	0.22
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	507	818	214	1387	113	172
Grp Volume(v), veh/h	105	1605	5	5	784	0	79	0	0	311	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1672	0	0
Q Serve(g_s), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Cycle Q Clear(g_c), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.14	0.83		0.10
Lane Grp Cap(c), veh/h	145	1750	780	73	1583		97	0	0	365	0	0
V/C Ratio(X)	0.73	0.92	0.01	0.07	0.50		0.81	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	229	1765	787	73	1583		97	0	0	552	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.9	22.7	11.9	47.2	18.4	0.0	47.5	0.0	0.0	38.7	0.0	0.0
Incr Delay (d2), s/veh	4.2	8.4	0.0	0.2	0.5	0.0	36.8	0.0	0.0	8.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	17.0	0.1	0.1	5.7	0.0	3.0	0.0	0.0	8.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.1	31.1	11.9	47.5	18.9	0.0	84.3	0.0	0.0	46.7	0.0	0.0
LnGrp LOS	D	C	B	D	B		F	A	A	D	A	A
Approach Vol, veh/h		1715			789	A		79			311	
Approach Delay, s/veh		32.2			19.1			84.3			46.7	
Approach LOS		C			B			F			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.8	53.2		26.5	8.5	57.5		10.5				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	13.5	41.5		33.0	4.0	51.0		6.0				
Max Q Clear Time (g_c+I1), s	8.2	18.7		20.4	2.3	47.1		7.2				
Green Ext Time (p_c), s	0.1	7.3		1.1	0.0	3.5		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			31.6									
HCM 6th LOS			C									

Notes
User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Future Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
Arrive On Green	0.13	0.43	0.43	0.18	0.79	0.76	0.23	0.23	0.23	0.12	0.12	0.12
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Cycle Q Clear(g_c), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
V/C Ratio(X)	0.71	0.48	0.47	0.83	0.51	0.51	0.26	0.65	0.97	0.21	0.72	0.87
Avail Cap(c_a), veh/h	614	1461	1015	397	1306	750	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.83	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	26.4	10.0	52.1	9.3	7.7	40.9	45.6	49.8	51.6	55.0	56.2
Incr Delay (d2), s/veh	1.8	1.1	1.5	8.0	1.2	2.1	0.1	3.3	39.8	0.4	7.4	27.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	7.6	11.8	3.8	2.5	3.5	2.6	8.0	14.3	1.3	5.3	6.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	27.5	11.5	60.1	10.5	9.7	41.0	48.9	89.6	51.9	62.4	83.7
LnGrp LOS	C	C	B	E	B	A	D	D	F	D	E	F
Approach Vol, veh/h		1495			1299			790			353	
Approach Delay, s/veh		21.0			19.7			64.1			70.7	
Approach LOS		C			B			E			E	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.9	60.4		19.7	21.1	55.2		34.0
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.5
Max Green Setting (Gmax), s	16.0	48.0		18.0	30.0	34.0		29.5
Max Q Clear Time (g_c+I1), s	11.6	21.5		15.4	16.2	15.3		30.3
Green Ext Time (p_c), s	0.3	15.5		0.2	0.9	15.8		0.0

Intersection Summary	
HCM 6th Ctrl Delay	33.7
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Future Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.87		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3313		1644	3358	1471	1693	1555		3317	1580	
Flt Permitted	0.24	1.00		0.21	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	422	3313		361	3358	1471	1693	1555		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	985	10	56	939	51	194	26	148	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	22	0	126	0	0	98	0
Lane Group Flow (vph)	51	995	0	56	939	29	194	48	0	224	86	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	77.3	72.6		76.1	72.0	72.0	19.2	19.2		16.7	16.7	
Effective Green, g (s)	78.3	74.0		76.1	73.4	73.4	20.2	19.2		16.7	16.7	
Actuated g/C Ratio	0.60	0.57		0.59	0.56	0.56	0.16	0.15		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	304	1885		251	1895	830	263	229		426	202	
v/s Ratio Prot	0.01	c0.30		c0.01	0.28		c0.11	0.03		c0.07	0.05	
v/s Ratio Perm	0.09			0.12		0.02						
v/c Ratio	0.17	0.53		0.22	0.50	0.03	0.74	0.21		0.53	0.43	
Uniform Delay, d1	19.9	17.2		23.3	17.1	12.6	52.4	48.7		52.9	52.2	
Progression Factor	0.58	0.61		0.40	0.46	0.06	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.9		0.2	0.8	0.1	10.3	0.5		0.8	0.8	
Delay (s)	11.7	11.5		9.4	8.6	0.8	62.7	49.2		53.7	53.1	
Level of Service	B	B		A	A	A	E	D		D	D	
Approach Delay (s)		11.5			8.3			56.3			53.4	
Approach LOS		B			A			E			D	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Future Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	131	1116	0	86	783	106	91	71	25	222	51	152
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	634	2049		279	1248	543	163	111	39	409	49	145
Arrive On Green	0.57	1.00	0.00	0.05	0.37	0.37	0.10	0.09	0.09	0.12	0.12	0.12
Sat Flow, veh/h	1688	3331	1502	1661	3383	1472	1674	1237	436	3326	395	1179
Grp Volume(v), veh/h	131	1116	0	86	783	106	91	0	96	222	0	203
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1472	1674	0	1673	1663	0	1574
Q Serve(g_s), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.26	1.00		0.75
Lane Grp Cap(c), veh/h	634	2049		279	1248	543	163	0	150	409	0	194
V/C Ratio(X)	0.21	0.54		0.31	0.63	0.20	0.56	0.00	0.64	0.54	0.00	1.05
Avail Cap(c_a), veh/h	634	2049		300	1379	600	476	0	463	409	0	194
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.00	0.87	0.87	0.87	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.1	0.0	0.0	29.6	33.7	27.9	56.0	0.0	57.2	53.6	0.0	57.0
Incr Delay (d2), s/veh	0.1	0.9	0.0	0.3	2.1	0.7	1.8	0.0	2.8	1.1	0.0	77.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.3	0.0	1.9	10.3	2.3	3.0	0.0	3.2	3.5	0.0	10.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.2	0.9	0.0	30.0	35.8	28.6	57.8	0.0	59.9	54.6	0.0	134.8
LnGrp LOS	B	A		C	D	C	E	A	E	D	A	F
Approach Vol, veh/h		1247	A		975			187			425	
Approach Delay, s/veh		2.3			34.5			58.9			92.9	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.4	84.0		20.0	42.4	52.0		15.7
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0
Max Green Setting (Gmax), s	8.0	* 53		16.0	* 9	* 52		36.0
Max Q Clear Time (g_c+I1), s	6.7	2.0		18.0	2.0	26.7		9.2
Green Ext Time (p_c), s	0.0	43.3		0.0	0.2	19.8		0.6

Intersection Summary		
HCM 6th Ctrl Delay		30.7
HCM 6th LOS		C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Future Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	77	1199	92	46	806	214	61	5	15	260	61	92
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	536	1282	570	425	1037	516	77	36	109	278	137	206
Arrive On Green	0.24	0.38	0.38	0.22	0.35	0.35	0.05	0.09	0.10	0.16	0.21	0.22
Sat Flow, veh/h	1688	3367	1498	1647	2941	1464	1701	384	1152	1701	641	967
Grp Volume(v), veh/h	77	1199	92	46	806	214	61	0	20	260	0	153
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1464	1701	0	1536	1701	0	1609
Q Serve(g_s), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Cycle Q Clear(g_c), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.75	1.00		0.60
Lane Grp Cap(c), veh/h	536	1282	570	425	1037	516	77	0	146	278	0	342
V/C Ratio(X)	0.14	0.94	0.16	0.11	0.78	0.41	0.79	0.00	0.14	0.93	0.00	0.45
Avail Cap(c_a), veh/h	536	1285	572	425	1123	559	139	0	419	278	0	570
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.79	0.79	0.79	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	27.0	32.7	13.9	33.8	31.7	10.9	52.0	0.0	45.5	45.4	0.0	37.5
Incr Delay (d2), s/veh	0.1	11.5	0.5	0.1	5.7	2.4	10.3	0.0	0.3	36.4	0.0	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	16.6	1.6	1.0	10.3	2.8	1.9	0.0	0.5	9.8	0.0	3.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	44.2	14.3	33.9	37.5	13.3	62.3	0.0	45.8	81.9	0.0	38.1
LnGrp LOS	C	D	B	C	D	B	E	A	D	F	A	D
Approach Vol, veh/h		1368			1066			81			413	
Approach Delay, s/veh		41.3			32.5			58.2			65.6	
Approach LOS		D			C			E			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	27.7	45.9	9.0	27.4	30.8	42.8	22.0	14.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	41.2	9.0	38.5	4.0	42.0	18.0	29.5
Max Q Clear Time (g_c+I1), s	2.0	39.7	5.9	11.1	2.0	28.9	18.6	3.3
Green Ext Time (p_c), s	0.0	1.4	0.0	0.6	0.0	9.9	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	42.0
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Future Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				295	742	16	416	53	0	0	37	5
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				357	956	21	734	870	0	0	750	101
Arrive On Green				0.39	0.39	0.39	0.82	0.82	0.00	0.00	0.49	0.49
Sat Flow, veh/h				910	2439	54	1398	1772	0	0	1527	206
Grp Volume(v), veh/h				546	0	507	416	53	0	0	0	42
Grp Sat Flow(s),veh/h/ln				1684	0	1719	1398	1772	0	0	0	1734
Q Serve(g_s), s				32.1	0.0	28.0	13.1	0.6	0.0	0.0	0.0	1.4
Cycle Q Clear(g_c), s				32.1	0.0	28.0	14.5	0.6	0.0	0.0	0.0	1.4
Prop In Lane				0.54		0.03	1.00		0.00	0.00		0.12
Lane Grp Cap(c), veh/h				660	0	674	734	870	0	0	0	851
V/C Ratio(X)				0.83	0.00	0.75	0.57	0.06	0.00	0.00	0.00	0.05
Avail Cap(c_a), veh/h				735	0	750	734	870	0	0	0	851
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.86	0.86	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				30.1	0.0	28.8	6.6	5.1	0.0	0.0	0.0	14.6
Incr Delay (d2), s/veh				11.4	0.0	7.6	2.7	0.1	0.0	0.0	0.0	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				14.9	0.0	12.9	2.7	0.3	0.0	0.0	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				41.5	0.0	36.4	9.4	5.2	0.0	0.0	0.0	14.6
LnGrp LOS				D	A	D	A	A	A	A	A	B
Approach Vol, veh/h					1053			469			42	
Approach Delay, s/veh					39.0			8.9			14.6	
Approach LOS					D			A			B	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				58.0		47.1		58.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				54.0		48.0		54.0				
Max Q Clear Time (g_c+I1), s				3.4		34.1		16.5				
Green Ext Time (p_c), s				0.1		9.0		2.2				

Intersection Summary			
HCM 6th Ctrl Delay			29.3
HCM 6th LOS			C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Future Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	89	895	0				0	379	284	16	316	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	153	1613					0	644	539	23	716	0
Arrive On Green	0.51	0.51	0.00				0.00	0.36	0.36	0.00	0.14	0.00
Sat Flow, veh/h	297	3143	1502				0	1772	1482	1647	1730	0
Grp Volume(v), veh/h	526	458	0				0	379	284	16	316	0
Grp Sat Flow(s),veh/h/ln	1757	1683	1502				0	1772	1482	1647	1730	0
Q Serve(g_s), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Cycle Q Clear(g_c), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Prop In Lane	0.17		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	902	864					0	644	539	23	716	0
V/C Ratio(X)	0.58	0.53					0.00	0.59	0.53	0.69	0.44	0.00
Avail Cap(c_a), veh/h	902	864					0	644	539	60	755	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	18.6	17.9	0.0				0.0	28.3	27.6	54.5	35.8	0.0
Incr Delay (d2), s/veh	2.8	2.3	0.0				0.0	3.9	3.7	20.0	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.8	8.2	0.0				0.0	8.4	6.2	0.6	8.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.3	20.2	0.0				0.0	32.2	31.2	74.5	36.1	0.0
LnGrp LOS	C	C					A	C	C	E	D	A
Approach Vol, veh/h		984	A					663			332	
Approach Delay, s/veh		20.8						31.8			37.9	
Approach LOS		C						C			D	

Timer - Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		60.5		49.5			5.5	44.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8
Max Green Setting (Gmax), s		54.0		48.0			4.0	39.2
Max Q Clear Time (g_c+I1), s		24.9		20.5			3.1	21.0
Green Ext Time (p_c), s		13.6		0.9			0.0	2.0

Intersection Summary			
HCM 6th Ctrl Delay			27.4
HCM 6th LOS			C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Future Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	200	895	158	11	789	21	105	26	11	53	21	158
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	599	2196	979	24	1025	457	203	263	111	341	39	293
Arrive On Green	0.35	0.65	0.65	0.01	0.32	0.32	0.21	0.22	0.21	0.21	0.22	0.21
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	200	895	158	11	789	21	105	0	37	53	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.5	13.8	4.5	0.7	24.3	1.1	8.9	0.0	1.9	3.5	0.0	11.6
Cycle Q Clear(g_c), s	9.5	13.8	4.5	0.7	24.3	1.1	20.5	0.0	1.9	5.4	0.0	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	599	2196	979	24	1025	457	203	0	374	341	0	332
V/C Ratio(X)	0.33	0.41	0.16	0.45	0.77	0.05	0.52	0.00	0.10	0.16	0.00	0.54
Avail Cap(c_a), veh/h	599	2196	979	74	1323	590	236	0	419	378	0	372
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.0	9.1	7.4	53.7	33.9	26.0	47.6	0.0	34.5	36.8	0.0	38.6
Incr Delay (d2), s/veh	0.2	0.6	0.4	7.9	5.6	0.2	1.5	0.0	0.1	0.2	0.0	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	5.0	1.5	0.3	10.0	0.4	2.9	0.0	0.8	1.2	0.0	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.2	9.6	7.8	61.7	39.5	26.2	49.1	0.0	34.5	37.0	0.0	39.7
LnGrp LOS	C	A	A	E	D	C	D	A	C	D	A	D
Approach Vol, veh/h		1253			821			142			232	
Approach Delay, s/veh		12.0			39.5			45.3			39.0	
Approach LOS		B			D			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.6	76.3		28.1	43.0	38.9		28.1
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5
Max Green Setting (Gmax), s	4.5	* 66		25.5	25.5	45.0		25.5
Max Q Clear Time (g_c+I1), s	2.7	15.8		13.6	11.5	26.3		22.5
Green Ext Time (p_c), s	0.0	19.2		0.6	0.4	8.6		0.1

Intersection Summary	
HCM 6th Ctrl Delay	25.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	150	35	800	25	40
Future Vol, veh/h	740	150	35	800	25	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	779	158	37	842	26	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	937	0	1274	390
Stage 1	-	-	-	-	779	-
Stage 2	-	-	-	-	495	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	703	-	162	614
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	584	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	703	-	153	614
Mov Cap-2 Maneuver	-	-	-	-	153	-
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	553	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	19.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	153	614	-	-	703	-
HCM Lane V/C Ratio	0.172	0.069	-	-	0.052	-
HCM Control Delay (s)	33.4	11.3	-	-	10.4	-
HCM Lane LOS	D	B	-	-	B	-
HCM 95th %tile Q(veh)	0.6	0.2	-	-	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Future Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	153	663	5	106	784	5	5	5	5	26	0	116
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	678	1754	789	704	1662	11	235	3	3	207	0	7
Arrive On Green	0.11	0.53	0.53	0.09	0.50	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3321	21	581	581	581	313	0	1395
Grp Volume(v), veh/h	153	663	5	106	385	404	15	0	0	142	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	1712	1743	0	0	1707	0	0
Q Serve(g_s), s	1.1	2.4	0.0	0.8	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.1	2.4	0.0	0.8	3.2	3.2	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.01	0.33		0.33	0.18		0.82
Lane Grp Cap(c), veh/h	678	1754	789	704	816	857	240	0	0	214	0	0
V/C Ratio(X)	0.23	0.38	0.01	0.15	0.47	0.47	0.06	0.00	0.00	0.66	0.00	0.00
Avail Cap(c_a), veh/h	2187	10812	4861	1697	4725	4963	2496	0	0	2385	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	3.5	2.9	2.3	3.5	3.4	3.4	10.4	0.0	0.0	10.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.1	0.0	0.1	0.3	0.3	0.1	0.0	0.0	2.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.6	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.7	3.0	2.3	3.6	3.7	3.7	10.5	0.0	0.0	13.0	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	B	A	A	B	A	A
Approach Vol, veh/h		821			895			15			142	
Approach Delay, s/veh		3.1			3.7			10.5			13.0	
Approach LOS		A			A			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.3	14.4		0.0	5.8	14.9		0.0				
Change Period (Y+Rc), s	4.0	7.0		4.0	4.0	7.0		4.0				
Max Green Setting (Gmax), s	21.0	57.0		27.0	14.0	64.0		27.0				
Max Q Clear Time (g_c+I1), s	3.1	5.2		0.0	2.8	4.4		0.0				
Green Ext Time (p_c), s	0.3	2.2		0.0	0.2	2.2		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			4.2									
HCM 6th LOS			A									

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Future Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	684	5	105	884	53	5	5	5	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	937	0	0	689	0	0	1346	1841	342	1476	-	-
Stage 1	-	-	-	-	-	-	694	694	-	1121	-	-
Stage 2	-	-	-	-	-	-	652	1147	-	355	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	727	-	-	901	-	-	110	74	654	88	0	0
Stage 1	-	-	-	-	-	-	399	442	-	220	0	0
Stage 2	-	-	-	-	-	-	423	272	-	635	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	727	-	-	901	-	-	100	65	654	74	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	100	65	-	74	-	-
Stage 1	-	-	-	-	-	-	396	439	-	218	-	-
Stage 2	-	-	-	-	-	-	374	240	-	618	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	1	42.7	61.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	111	727	-	-	901	-	-	74
HCM Lane V/C Ratio	0.142	0.007	-	-	0.117	-	-	0.142
HCM Control Delay (s)	42.7	10	-	-	9.5	-	-	61.6
HCM Lane LOS	E	A	-	-	A	-	-	F
HCM 95th %tile Q(veh)	0.5	0	-	-	0.4	-	-	0.5

SECTION 4. VALUE OF TRAVEL TIME SAVINGS ASSUMPTIONS AND CALCULATIONS

DKS

TRAVEL TIME SAVINGS

The memorandum on Benefit Cost Analysis Guidance[18] uses the following value of travel time savings (VTTS) categories:

- Business travel – Estimated at $27.90 for the United States.
- Personal travel – Estimated at $16.50 for the United States.

These categories are averaged using a weight of 88.2% for Personal travel and 11.8% for Business travel resulting in a VTTS for All Purposes of $17.90.

A comparison of median household income and median employee compensation indicates that the City of Sandy and the Portland-Vancouver-Hillsboro metropolitan area exceed the national level for both categories.

- Business travel – Estimated at $29.64.[19]
- Personal travel – Estimated at $17.81.[20]

These categories were averaged using the same splits for Personal and Business travel resulting in a VTTS of $19.21.

For truck drivers the recommended rate of $30.80 (2019 dollars) was used resulted in a 2021 value of $32.19.

Vehicle occupancy information was averaged from two sources:

- NHTS[21] 5 p.m. weekday average vehicle occupancy for the Portland-Vancouver-Hillsboro: 1.44
- 2019 American Community Survey[22] 5-year estimates workers per car, truck or van for the City of Sandy: 1.07

This results in an estimated average vehicle occupancy of 1.26 for the weekday p.m. peak hour.

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[18] United States Department of Transportation, 2021

[19] Calculated using $19.83 (2019 dollars) from the Bureau of Labor Statistics median compensation for the State of Oregon and scaled based on the methodology outlined in the Revised Value of Travel Time Guidance (2016). Then finally increased to 2021 dollars.

[20] Calculated based on the weighted average of 60% 2019 Sandy household median income and 40% 2019 Oregon household median income. This is based on the assumption that up to 40% of trips using the bypass will not be local. This average was scaled using the methodology outlined in the Revised Value of Travel Time Guidance (2016). Then finally increased to 2021 dollars.

[21] National Household Travel Survey, 2017

[22] US Census Bureau, Commuting Characteristics by Sex, S0801

Approximately 1,500 vehicles are estimated to use the proposed bypass during the peak hour with 1,200 through trips and 300 local trips. The individual origin-destination of these local trips is unknown so only the 1,200 through trips were used to evaluate the value of travel time savings (VTTS). Of these 1,200, 720 are eastbound trips and 480 are westbound trips. The percentage of truck drivers is estimated to be 3 percent in the eastbound direction (22 truck drivers) and 4 percent in the westbound direction (19 truck drivers). The final estimated traveler characteristics are shown in Table 1.

TABLE 1: TRAVELER CHARACTERISTICS OF BYPASS USERS

	General Travel	Commercial Drivers
Eastbound	**879**	**22**
Westbound	**581**	**19**

The bi-directional travel time on the proposed bypass is estimated to be 7 minutes 56 seconds with interchanges at either end of the bypass and a traffic signal at the intersection with OR 211. The eastbound travel time with Alternative #1 is estimated at 13 minutes 20 seconds; the westbound travel time is estimated at 10 minutes 15 seconds.

In the eastbound direction, the estimated travel time savings is 80 person-hours (40%) and in the westbound direction the travel time savings is estimated at 53 person-hours (40%). Using a weighted VTTS of $19.53 for the eastbound direction and $19.62 for the westbound direction (to account for commercial drivers) the total travel time savings value is $2,600 (2021 dollars). Extending this to an annual weekday p.m. total, the value is approximately $675,000 per year. If weekday p.m. peak hour conditions exist daily (including weekends) then the value of the travel time savings is approximately $950,000 per year.

SECTION 4. POLICY AND REGULATORY CONSIDERATION MEMO

MEMORANDUM

Task 4.1 Final Policy and Regulatory Considerations Memo

City of Sandy Bypass Feasibility Reevaluation

DATE	May 7, 2021
TO	Reah Flisakowski, DKS
FROM	Darci Rudzinski and Emma Porricolo, APG
CC	Kevin Chewuk, and Dock Rosenthal, DKS

INTRODUCTION

This memorandum provides a detailed evaluation of the policy and regulatory considerations associated with a potential bypass of the existing US 26 around the south side of the city of Sandy. A potential US 26 bypass was one of three concepts developed and evaluated during the 2011 Sandy Transportation System Plan (TSP) update to enhance connectivity, provide access to developing lands, and address congestion in the existing US 26 corridor. The bypass option is being reexamined in preparation for the current TSP update as a two-lane facility (one lane in each direction) around the south side of the City with an interchange at the west terminus (a point west of Orient Drive) and an interchange at the east terminus (near Firwood Road). As was the case in the analysis that led to the adoption of the 2011 TSP, a bypass would be part of a package of improvements that would include local system enhancements and highway improvements. The state and local policy and regulatory framework for updating the TSP is reviewed in Technical Memorandum 1: Policy Framework and Code Review. This memorandum is focused only on the additional considerations related to a bypass; the evaluation herein references both the January 2021 Policy Framework and Code Review as well as work developed as part of the 2011 TSP.[1]

As noted in the 2011 transportation analysis, the construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

[1] Technical Memorandum #3, Transportation Alternatives and Improvement Strategies, February 25, 2011, City of Sandy TSP Update.

ANGELO PLANNING GROUP
921 SW Washington Street, Suite 468
Portland, OR 97205
angeloplanning.com
p: 503.224.6974
f: 503.227.3679

The applicable state and local policy documents are:

- Oregon Highway Plan (OHP)
- Oregon Statewide Planning Goals
- Transportation Planning Rule (TPR)

POLICY AND REGULATORY REVIEW

Oregon Highway Plan

Planning for a bypass would be undertaken as a new facility plan[2] project, developed in partnership with ODOT, the City of Sandy, and Clackamas County consistent with Oregon Highway Plan (OHP) Policy 2A: Partnerships. Ultimately, a facility plan for a new bypass would be adopted by the Oregon Transportation Commission (OTC) as an amendment to the OHP. Planning for new bypasses is governed by OHP Policy 1G: Major Improvements and Policy 1H: Bypasses.

Policy 1G: Major Improvements

Policy 1G states that existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. When developing transportation solutions, the priority is to maintain the existing system first by improving functionality through means such as access management, transportation demand management, and improved traffic operations. Where this strategy is unable to meet the project objectives, the focus should then shift to improvements to efficiency and capacity of existing facilities, followed by adding capacity to existing facilities, and lastly to constructing new facilities.

The construction of a new facility such as a bypass is categorized under the lowest level of priority under this policy. Therefore, the planning process must demonstrate that alternatives that do not include a bypass cannot adequately support safety, growth management, and other livability and economic objectives. As identified in a previous analysis,[3] this would include demonstrating that:

- The improvement is needed to satisfy a state transportation objective or objectives.
- The scope of the project is reasonably identified, considering the long-range projection of need.
- The improvement is identified through a planning process that includes:
    - A robust public involvement process;
    - An evaluation of reasonable transportation and land use alternatives including measures for managing the existing transportation system and for reducing demands for highway capacity; and
    - Sufficient environmental analysis at the fatal flaw analysis level.

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[2] Facility plans are defined as plans developed by ODOT for state highway facilities and include corridor facility plans and transportation refinement plans.
[3] The list is from OHP Action 1G.2 and has been modified slightly, both from the OHP source document and from items originally included in Technical Memorandum #3, Transportation Alternatives and Improvement Strategies.

- The plan includes measures to manage the transportation system, and demonstrates that these measures will not satisfy identified highway needs during the planning period or there is a need to preserve a future transportation corridor for future needs beyond the planning period.
- The improvement would be a cost-effective means to achieve the objective(s).
- The proposed timing of the improvement is consistent with priorities established in corridor plans and regional transportation plans.
- Funding for the project can reasonably be expected at the time the project is ready for development and construction.
- Local street improvements proposed as part of the major improvement would be funded through the local transportation financing program.
- The plan includes policies and implementing measures that protect the corridor and its intended function.

Also, Policy 1G: Major Improvements calls for the implementation of a cost-sharing agreement where major improvements benefit the local system.

Policy 1H: Bypasses

Bypasses are highways designed to maintain or increase statewide or regional mobility and they generally divert pass through vehicle trips around a downtown, or an urban or metropolitan area. If a bypass were constructed around Sandy, it is likely to be designed as a limited access facility to protect its functional life as an alternate route around Sandy.

The objectives of the Bypass Policy are:

- To maintain and enhance the utility of the state highway investment,
- To assure land uses that are consistent and compatible with Oregon statewide land use goals,
- To identify the appropriate function of bypasses in the transportation system, and
- To guide the long-term operation of bypasses through agreement on land use and transportation management actions.

In addition, there are actions included in the policy which require:

- ODOT and the affected local governments to identify the need for a bypass in a Transportation System Plan and/or Corridor Plan in a manner consistent with Oregon Highway Plan Policy 1G.
- ODOT and the affected local governments to use a refinement plan and/or a NEPA process to consider alternatives and assess potential impacts.
- Establishment of management agreements between ODOT and the affected local governments to protect the facility investment.
- Design for moderate to high-speed travel, consistent with freeway or expressway facilities.
- Prohibition of direct private property access and a limited number of public access points.
- Development of management plans for new interchanges and other bypass elements.

- Adoption of an acknowledged TSP that incorporates the Oregon Highway Plan Bypass policies.
- Adoption of local ordinances that provide for adequate connectivity to complement the bypass.
- Consideration of re-zoning properties that could adversely impact the facility.
- Consideration of potential local participation in financing.
- Consideration of a jurisdictional transfer of the bypassed highway.

The first bullet in the list above dictates that ODOT, Sandy, and Clackamas County would identify the need for a bypass in a facility plan and/or adopted local transportation system plans (see *Steps to Adoption* in this memorandum). Subsequent steps move into the National Environmental Policy Act (NEPA) process, with decisions becoming more refined as the facility's location and design become more specific. A demonstration of the purpose and need for a US 26 bypass around Sandy would not only provide a basis for studying such an improvement, it is a critical first step in the decision-making process of evaluating alternatives in a manner that complies with NEPA requirements.

As the last bullet in the list implies, a possible outcome of a future bypass would be jurisdictional transfer of the existing US 26 corridor that runs through Sandy from ODOT control to the City. This would shift maintenance responsibilities to the City and future improvements and access would be consistent with a local street functional classification and its associated standards.

Oregon Statewide Planning Goals

Goal 3 and Goal 4

Findings of consistency with the Statewide Planning Goals would need to support the adoption of a bypass facility plan and associated recommended changes to local plans. At least portions of a proposed bypass would be located in the rural lands of Clackamas County. Land south of the City of Sandy, outside the City's urban growth boundary (UGB), would likely include parcels zoned for exclusive farm use (EFU) and forest use (Timber District, TBR). EFU is a state regulated designation that is intended to preserve land for farm- and forest-related uses.

Statewide Planning Goal 3, to preserve and maintain agricultural lands, is implemented by the Oregon Administrative Rule (OAR) 660-033. OAR 660-033-0012, Table 1, identifies transportation facilities and improvements that are permitted on Agricultural lands. Included in the Uses Authorized on Agricultural Lands are transportation improvements on rural lands allowed by OAR 660-012-0065. This is a subsection of the Oregon Transportation Planning Rule (TPR) that identifies transportation improvements that may be allow on rural lands, consistent with Goal 3 and Goal 4, Forest Lands.

Forest lands are also considered a resource land designation and have specific state protections that are implemented through local ordinances. Pursuant to OAR chapter 660, Division 6, the County may allow transportation-related uses in the TBR zone designated lands, including road widening within existing rights-of-way in conformance with the transportation element of acknowledged comprehensive plans and public road and highway projects as described in ORS 215.213(1) and 215.283(1).[4]

A new four-lane bypass alignment that impacted EFU or Forest (Timber) lands would require a goal exception. The goal exception would be a reasons exception with findings pursuant to ORS 197.732.[5] Clackamas County would be the approving body for a goal exception, which would need to be supported by findings of fact and "reasons" statements documenting why state policy – in this case Goal 3 Agricultural Lands and/or Goal 4 Forest Lands, depending on the parcel's zoning – should not apply.

A reasons exception needs to document that there is no alternative area that could reasonably accommodate the improvement and that the long term environmental, economic, social and energy (ESEE) consequences have been evaluated and the proposed roadway and its interchanges have been designed to reduce adverse impacts and, to the extent possible, is compatible with adjacent uses. That analysis must include showing that the solutions to the defined problem cannot be accommodated in any areas that wouldn't require a goal exception, that the proposed improvements' impact on the subject goal exception area are not any worse than those associated with other alternatives, and that the improvements can be designed to minimize adverse impacts. In other words, the proposed transportation improvement must be shown to be compatible with other adjacent uses or will be made so through specified measures to reduce adverse impacts. The County and City may need to show how the adoption of a facility design and associated land use measures minimize the accessibility of rural lands from the proposed bypass and that adoption also supports the continued use of surrounding rural lands.

Goal 5

Goal 5, Natural Resources, Scenic and Historic Areas, and Open Spaces, states that local governments shall "adopt programs that will protect natural resources and conserve scenic, historic, and open space resources for present and future generations." Cities and counties are to maintain inventories for the following:

- Riparian corridors (including water and riparian areas and fish habitat)
- Wetlands
- Wildlife habitat
- Federal wild and scenic rivers
- State scenic waterways
- Groundwater resources
- Approved Oregon recreation trails
- Natural areas
- Wilderness areas

[4] ORS 215.213(1) and 215.283(1) address uses permitted in exclusive farm use zones; transportation improvements are basically limited on EFU lands to modification, improvement, or realignment of existing roadways and highways.
[5] https://www.oregonlaws.org/ors/197.732

- Mineral and aggregate
- Energy sources
- Cultural areas

Analysis supporting the 2011 TSP identified constraints to land and public infrastructure development related to Sandy's location at the base of Mt. Hood and the foothills terrain. Environmental and topographic constraints limit options to provide an effective transportation network in specific areas. Constraints include, but are not limited to:

- steep slopes in the northeast that severely limit the feasible expansion of transportation facilities to provide alternate routes to US 26 east of Bluff Road and Tickle Creek; and
- salmon-bearing streams and wetlands running parallel to US 26 along the southern end of the City.

In addition to required Goal 5 inventories, local governments are encouraged to inventory:

- Historic resources
- Open spaces
- Scenic views and sites

The City's TSP supports environmental resource protection through the following adopted Environmental Goal: "Avoid or mitigate transportation project impacts to environmental resources including creeks and wetlands, cultural resources, and wildlife corridors." The TSP also includes protection of scenic resources and the City's historic character under "Community Goals."

Impacts to Goal 5 resources, in particular to those that are mapped and associated with specific County or City protection or mitigation requirements, would be a criterion by which to evaluate proposed bypass alignments. Where mapped Goal 5 lands are impacted, a goal exception may be needed to support the bypass "preferred alternative" - the selected bypass alignment and associated project improvements. The preferred alternative would then be further studied for refinements that could mitigate or minimize any potential impact to Goal 5 resources.

Goal 12, Transportation

Goal 12, Transportation, is implemented by OAR 660 Division 12, known as the Transportation Planning Rule or "TPR." The Clackamas County TSP and the Sandy TSP must be consistent with each other, and both have to be consistent with adopted elements of the state TSP, including the OHP. Cities and counties adopt regional and local TSPs required by the TPR as part of their comprehensive plans.

Transportation Planning Rule (OAR 660-012)

The Transportation Planning Rule (TPR) identifies transportation facilities, services, and improvements that may be permitted on rural lands consistent with Goals 3, 4, 11, and 14 without a goal exception (Transportation Improvements on Rural Lands **660-012-0065**). As described in the Goal 3 and Goal 4 section of this memorandum, transportation improvements on rural resource lands are largely limited to modifications, improvements, or realignments of existing roadways and highways. In order to plan for and adopt elements of a bypass facility plan, in the case that the preferred alignment impacts EFU or Forest lands, Clackamas County will need to support adoption with goal exception findings.

STEPS TO ADOPTION

As discussed earlier in this memorandum, a preferred bypass alternative would be documented in a facility plan. Pursuant to OAR 734-051-7010, the OTC ultimately adopts facility plans, thereby amending the OHP. Prior to adoption by the OTC, ODOT, the City of Sandy, and Clackamas County would work collaboratively on developing any amendments to local comprehensive plans and TSPs and local land use and subdivision codes that are necessary to support the plan for the proposed bypass and to ensure that its recommendations are consistent with local plans and codes. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities of the different levels of government are not the same.

Both the City of Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. In addition to adopting planned improvements on the local systems associated with the bypass and interchanges, local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. In addition, new ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that access management, land use management, and coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County. As discussed in the previous section, if the preferred bypass alignment impacts County land designated for EFU or Forest use, the County would need to support adoption with goal exception findings.[6] Following successful local adoption by the City and County, the facility plan can be presented to the OTC for its review and approval.

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[6] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)

Staff Report

Meeting Date:	March 5, 2022
From	Jordan Wheeler, City Manager
SUBJECT:	City Council Goals Update

PURPOSE / OBJECTIVE:
Receive an update and review the status 2021-22 City Council Goals. Reprioritize or amend goals as needed.

BACKGROUND / CONTEXT:
In 2021, the City council held three visioning and goal setting meetings that resulted in a set of prioritized goals for 2021 and 2022 that were adopted on March 8, 2021:

Plan and provide sustainable infrastructure
- Complete the alternatives discharge including the analysis of constructed wetlands and incorporate into the Wastewater Facilities Plan
- Continue progress on Bell Street/362nd road improvements
- Evaluate our current water suppliers relationships and adopt Water Master Plan.
- Complete the transportation system plan and prioritize projects.
- Continue to grow SandyNet to make it self-sufficient for the long-term
- Implement the transit master plan

Be proactive in managing and planning for growth
- Collaborate with the Planning Commission to develop policy and provide criteria for approving and/or recommending variances and zone changes
- Begin the update of the City's Comprehensive Plan
- Update the development code

Foster economic recovery and growth
- Develop a COVID-19 community recovery plan (i.e. business recovery, utility payment assistance plan, etc.)
- Develop a long-term plan for economic development that provides clear direction for commercial, industrial, small business growth

Update Council policies and rules
- Maintain financial strength and sustainability
- Diversify revenue sources, analyze new revenue streams, look at cost recovery where possible

Collaborate with regional and community partners to address homelessness

- Appoint a homelessness task force
- Create a plan to address homelessness in Sandy
- Engage the community on community issues and in celebration
- Develop a strategy to engage and involve more people before decisions are made
- Celebrate Sandy's history and 110th anniversary

Expand recreation opportunities that align with community needs

- Appoint a committee to guide the next steps for the Community Campus and aquatics
- Complete the parks and trail master plan
- Develop a plan for the Community Campus
- Explore Council and community recreation services needs and determine how the organization can support this
- Incorporate biodiversity into our parks and green space

The current status of the goals are attached.

LIST OF ATTACHMENTS/EXHIBITS:

1. 2021-21 City Council Goals Status Update
2. 2021-23 City Council Goal Setting Summary Report

City of Sandy
2022 Work Plan
Council City Goals Status

Goal	Actions	Project Lead	Timeline	Status as of February 2022
Plan and provide sustainable infrastructure	Implement the next phase of the wastewater facilities plan and move forward with adequate funding	Public Works	Fall 2022	• WIFIA application submitted. Loan targeted to be closed by May 15, 2022. • City received $14.7 million in ARPA funds from the State. • Collection System basins 2 and 8 to be completed March 2022. • Collection System basins 6 and 7 design underway with construction in summer 2022. • Wastewater treatment plant improvements 50% complete.
	Complete the alternatives discharge including the analysis of constructed wetlands and incorporate into the Wastewater Facilities Plan	Public Works	Fall 2021	• NPDES Permitting work underway with application to be submitted mid 2022. • Draft temperature alternatives analysis completed. • Preliminary indirect discharge to groundwater study complete. Next studies on shallow infiltration underway.
	Continue progress on Bell Street/362nd road improvements	Public Works	Spring 2021	• 90% design completed and project cost estimate updated. • Offers to properties sent. • Land use application under review. • Project to go to bid in March.

	Evaluate our current water suppliers relationships and adopt Water Master Plan	Public Works	May 2021	• Council selected the option to treat raw water purchased from Portland Water Bureau and explore local groundwater resources. • Groundwater study to be completed by May 2022. • Draft Water Master Plan to be presented May 2022 and must be sent to OHA by July 1, 2022.
	Complete the transportation system plan and prioritize projects	Development Services	Completion: Fall 2022	• Three CAC meetings have been held, public survey #1 is complete, work session with Council and PC occured in December 2021, and Bypass Feasibility Study has been published.
	Continue to grow SandyNet to make it self-sufficient for the long-term	SandyNet	Ongoing	• Implement council approved plans to work towards this goal. • Create and implement SandyNet master plan • SandyNet Advisory Board is evaluating plans for rate increase(s).
	Implement the transit master plan	Transit	Ongoing	• Have funding awarded and ODOT approval for a fully funded (no match required) fully electric shift change vehicle (SUV). • Applied for planning funds for 3 future construction projects (new or improved administrative space at OPS, new maintenance bay at OPS, garage doors on new bus barns). • Obtained funding to maintain service levels even in "gloom" scenario such as high contractor costs and/or reduced payroll tax/fares collections. • In process (RFP out) new/upgraded on board technology equipment. • In process of a rebuild of an older diesel transit bus as replacement vehicle, moving forward on an alternative fuel process.

Be proactive in managing and planning for growth	Collaborate with the Planning Commission to develop policy and provide criteria for approving and/or recommending variances and zone changes	Development Services	Spring 2021	• Work session held on 6/7/21; direction on variances, code deviations, planned developments, and other code priorities was provided to staff. • Planned Developments removed from Development Code.
	Begin the update of the City's Comprehensive Plan	Development Services	Completion: Winter 2023	• Council approved 3J as the contractor with an expenditure of $251k on 12/6/21. • Official project kickoff occuring March 7, 2022
	Update the development code	Development Services	Ongoing	• Ongoing. Next code updates: Parks Code, Building Code, Senate Bill 458, Land Divisions, Sign Code. • Clear and Objective Code Audit RFP published.
Foster economic recovery and growth	Develop a COVID-19 community recovery plan (i.e. business recovery, utility payment assistance plan, etc.)	Admin	Q2 2021	• Additional ARPA funded business relief program anticipated to be brought to Council for approval in winter 2022.
	Develop a long-term plan for economic development that provides clear direction for commercial, industrial, small business growth	Economic Development	Q4 2022	• RFP for Economic Development Strategic Plan was published; proposals are currently being received. Proposals will be reviewed and a consultant recommended by the Economic Development Advisory Board.
Update Council policies and rules		City Council / Admin	2022	• Mayor and Councilor Hokanson currently reviewing proposed rules edits from staff, based on LOC model
Maintain financial strength and sustainability	Diversify revenue sources, analyze new revenue streams, look at cost recovery where possible	Finance	Ongoing	• In progress - comprehensive review of current fees and charges compared to other cities within Clackamas County - future work session to review in Spring 2022 with implementation beginning July 1.
Collaborate with regional and community partners to address homelessness	Appoint a homelessness task force	Admin/ Police	Spring 2021	• Task Force presented initial proposals for Council consideration: Camping and RV parking ordinances, and options for increasing services.

				• Adopt new and revised ordinances.
	Create a plan to address homelessness in Sandy	Admin/ Police	Winter 2022	• Camping ordinance amendments adoption anticipated for Spring 2022. Working with community partners to schedule a community forum on homelessness anticipated for March/April 2022.
Engage the community on community issues and in celebration	Develop a strategy to engage and involve more people before decisions are made	Admin	Summer 2021	• Sandy Speaks launched in late fall 2021.
	Celebrate Sandy's history and 110th anniversary	Parks & Recreation/ Library	Summer 2021	• 110th Anniversary programs were a success. Special events being planned for 2022.
Expand recreation opportunities that align with community needs	Appoint a committee to guide the next steps for the Community Campus and aquatics	City Council	Winter 2021	• In progress. The Parks and Recreation Dept. is developing a Technical Advisory Committee that will then guide 3 focus groups (rec/senior/park) through the next process in the Community Campus concept phase.
	Complete the parks and trails master plan	Parks & Recreation	Summer 2021	• Completed and adopted by Council. • Currently working on removing duplication of trails in the TSP and PTSMP with DKS and ESA.
	Develop a plan for the Community Campus	Parks & Recreation	Fall 2022	• In progress. The goal is to concept plan for the full site by May 2022.
	Explore Council and community recreation services needs and determine how the organization can support this	Parks & Recreation	Summer 2021-2022	• In progress. The P&R Director is working on hiring several full time positions which will support community recreation services. A current analysis of service and programs is being reviewed and studied.
	Incorporate biodiversity into our parks and green space	Parks & Recreation	Ongoing	• In progress. The P&R Department is working on exploring options, funding, and timing to plant pollinator gardens. One site identified are the community gardens at Bornstedt Park.

2021- 2023 City Council Goals

Draft Prepared March 4, 2021

Introduction

The City of Sandy is pleased to present the summary of their annual goal-setting retreat. The City Council and Management Team conducted a three-day virtual retreat January 26, January 27, and February 13, 2021 to review the Council's goals, discuss current community projects and issues, and provide City staff with direction regarding the Council's priorities for the coming years. The City contracted with SSW Consulting, a professional strategic planning and facilitation firm to prepare and guide the group through their discussion. In advance of the retreat, SSW conducted outreach with the Council and staff to discuss community challenges, opportunities, and priorities on the horizon. The agenda for the discussion was based on the following outcomes identified through the outreach process:

» Identify a shared vision and goals for the City;
» Identify high-level goals and prioritize them to provide realistic, focused direction for the organization;
» Identify the mission and vision to guide the comprehensive plan process;
» Define clear roles and relationships;
» Enhance the partnership between the Governing Body and Staff; and,
» Understand the team's communication styles and develop a team agreement that will help us move the goals forward.

The City Council and staff worked closely together to identify goals for the next two years that would build on the work and success of previous years, while also addressing new challenges and shifting community needs. The City will work on these goals in addition to maintaining high-quality core City services.

The City Council and staff look forward to working together with the community and our partners as we set out to achieve these goals.

- Sandy City Council + Management Team

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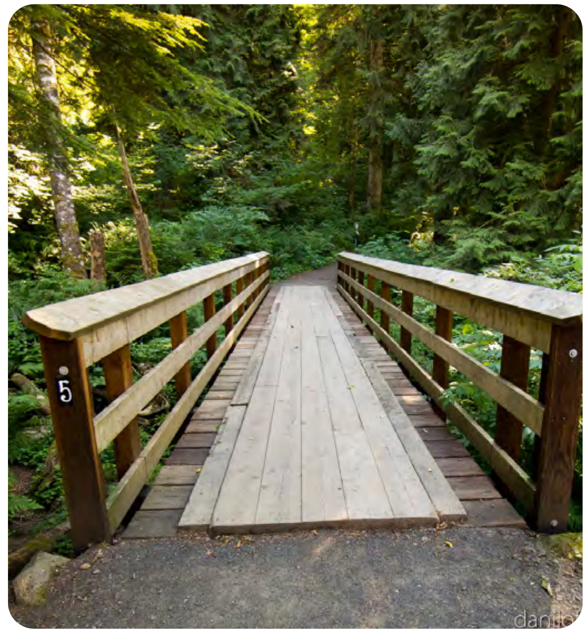


Our Team

City Council

Mayor Stan Pulliam
Councilor Jeremy Pietzold
Councilor Laurie Smallwood
Councilor Carl Exner
Councilor Richard Sheldon
Councilor Kathleen Walker
Councilor Don Hokanson

Management Team

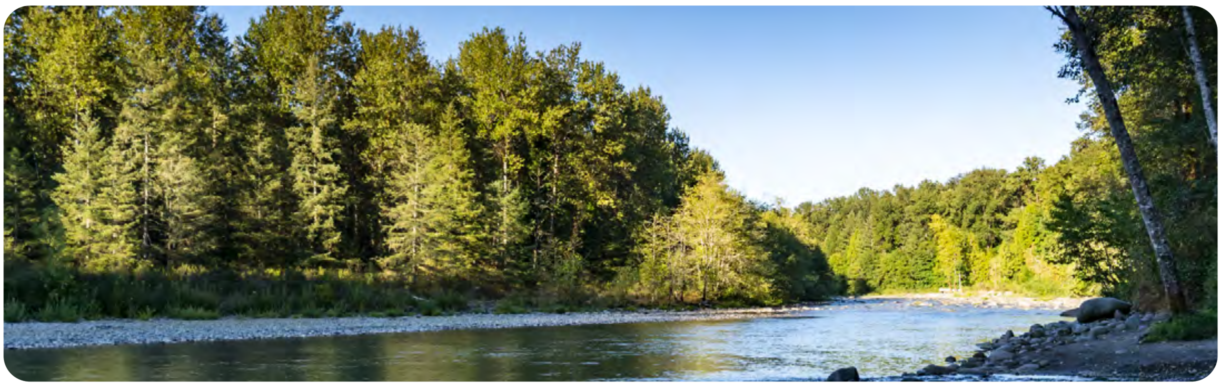
Jordan Wheeler, City Manager
Tyler Deems, Deputy City Manager/Finance Director
Jeff Aprati, Assistant to the City Manager/City Recorder
Andi Howell, Transit Director
Greg Brewster, IT Director
Ernie Roberts, Police Chief
Kelly O'Neill, Development Services Director
Mike Walker, Public Works Director
Angie Welty, Human Resources Director
Tanya Richardson, Community Services Director
Sarah McIntyre, Library Director

Consultant/Facilitator

Sara Singer Wilson, Principal/Owner
SSW Consulting

Sandy

Vision



Aligning With the Vision

The City of Sandy is preparing to embark on an update of the City's Comprehensive Plan which will define how the City wants to develop and grow in the future. In preparation for this planning exercise, the team imagined how they wanted to see the City of Sandy look, feel and function 20 years from now. Through this visioning exercise, they developed the vision statement below. The Council plans to continue their discussion of the vision statement at a future City Council Work Session.

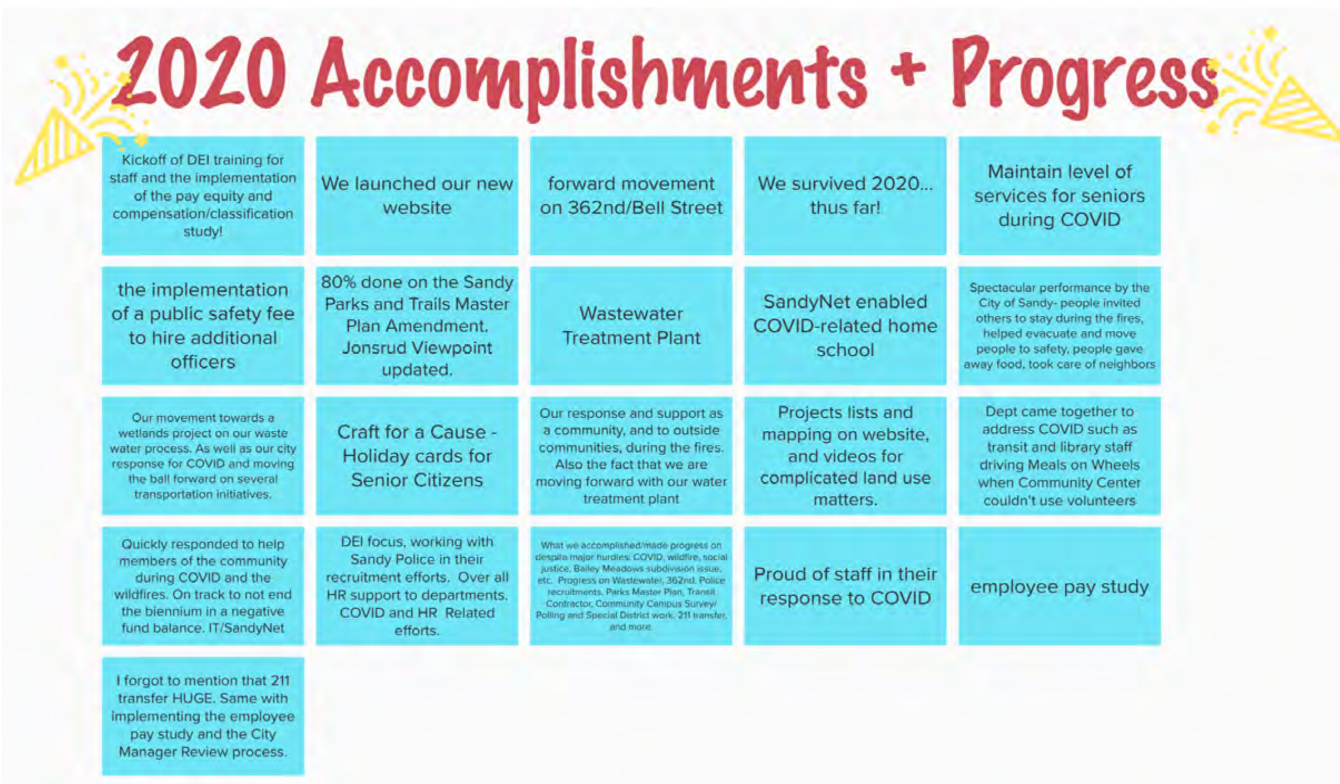
Vision

A gateway destination to nature and recreation away from the busyness, where we are connected to each other and our history of being pioneers and innovators - the Sandy way of living. Sandy is a community that values neighborhood livability for all and thriving local businesses.

Setting

The Context

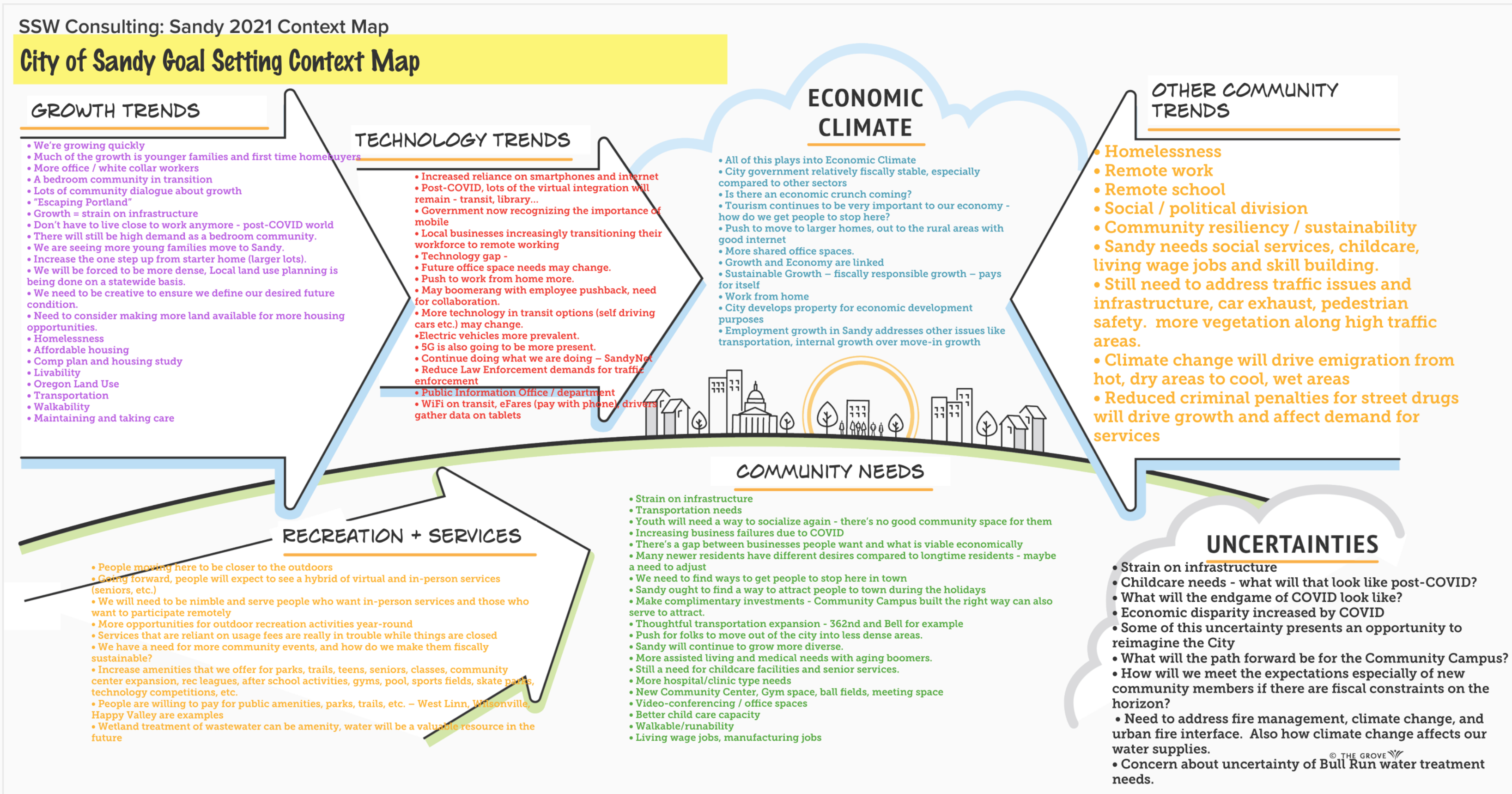
The team celebrated progress and accomplishments from 2020 as highlighted in the graphic below:



Context Map

The City Council and Staff discussed other various topics to help establish a shared context for the goal setting process. These topics included growth trends, technology trends, economic climate, other community trends, recreation and services, community needs, and uncertainties.

All organizations work in a context, there are larger environmental forces and trends that shape what is and is not possible just as much as the internal capacities and capabilities of a group. The context map on the following page develops a big-picture view of the Sandy environment and increases understanding of complex situations. This exercise assisted the team in establishing their common backdrop for the goal-setting.


SSW Consulting: Sandy 2021 Context Map
City of Sandy Goal Setting Context Map
GROWTH TRENDS
• We're growing quickly
• Much of the growth is younger families and first time homebuyers
• More office / white collar workers
• A bedroom community in transition
• Lots of community dialogue about growth
• "Escaping Portland"
• Growth = strain on infrastructure
• Don't have to live close to work anymore - post-COVID world
• There will still be high demand as a bedroom community.
• We are seeing more young families move to Sandy.
• Increase the one step up from starter home (larger lots).
• We will be forced to be more dense, Local land use planning is being done on a statewide basis.
• We need to be creative to ensure we define our desired future condition.
• Need to consider making more land available for more housing opportunities.
• Homelessness
• Affordable housing
• Comp plan and housing study
• Livability
• Oregon Land Use
• Transportation
• Walkability
• Maintaining and taking care
TECHNOLOGY TRENDS
• Increased reliance on smartphones and internet
• Post-COVID, lots of the virtual integration will remain - transit, library...
• Government now recognizing the importance of mobile
• Local businesses increasingly transitioning their workforce to remote working
• Technology gap -
• Future office space needs may change.
• Push to work from home more.
• May boomerang with employee pushback, need for collaboration.
• More technology in transit options (self driving cars etc.) may change.
•Electric vehicles more prevalent.
• 5G is also going to be more present.
• Continue doing what we are doing – SandyNet
• Reduce Law Enforcement demands for traffic enforcement
• Public Information Office / department
• WiFi on transit, eFares (pay with phone), drivers gather data on tablets
ECONOMIC CLIMATE
• All of this plays into Economic Climate
• City government relatively fiscally stable, especially compared to other sectors
• Is there an economic crunch coming?
• Tourism continues to be very important to our economy - how do we get people to stop here?
• Push to move to larger homes, out to the rural areas with good internet
• More shared office spaces.
• Growth and Economy are linked
• Sustainable Growth – fiscally responsible growth – pays for itself
• Work from home
• City develops property for economic development purposes
• Employment growth in Sandy addresses other issues like transportation, internal growth over move-in growth
OTHER COMMUNITY TRENDS
• Homelessness
• Remote work
• Remote school
• Social / political division
• Community resiliency / sustainability
• Sandy needs social services, childcare, living wage jobs and skill building.
• Still need to address traffic issues and infrastructure, car exhaust, pedestrian safety. more vegetation along high traffic areas.
• Climate change will drive emigration from hot, dry areas to cool, wet areas
• Reduced criminal penalties for street drugs will drive growth and affect demand for services
RECREATION + SERVICES
• People moving here to be closer to the outdoors
• Going forward, people will expect to see a hybrid of virtual and in-person services (seniors, etc.)
• We will need to be nimble and serve people who want in-person services and those who want to participate remotely
• More opportunities for outdoor recreation activities year-round
• Services that are reliant on usage fees are really in trouble while things are closed
• We have a need for more community events, and how do we make them fiscally sustainable?
• Increase amenities that we offer for parks, trails, teens, seniors, classes, community center expansion, rec leagues, after school activities, gyms, pool, sports fields, skate parks, technology competitions, etc.
• People are willing to pay for public amenities, parks, trails, etc. – West Linn, Wilsonville, Happy Valley are examples
• Wetland treatment of wastewater can be amenity, water will be a valuable resource in the future
COMMUNITY NEEDS
• Strain on infrastructure
• Transportation needs
• Youth will need a way to socialize again - there's no good community space for them
• Increasing business failures due to COVID
• There's a gap between businesses people want and what is viable economically
• Many newer residents have different desires compared to longtime residents - maybe a need to adjust
• We need to find ways to get people to stop here in town
• Sandy ought to find a way to attract people to town during the holidays
• Make complimentary investments - Community Campus built the right way can also serve to attract.
• Thoughtful transportation expansion - 362nd and Bell for example
• Push for folks to move out of the city into less dense areas.
• Sandy will continue to grow more diverse.
• More assisted living and medical needs with aging boomers.
• Still a need for childcare facilities and senior services.
• More hospital/clinic type needs
• New Community Center, Gym space, ball fields, meeting space
• Video-conferencing / office spaces
• Better child care capacity
• Walkable/runability
• Living wage jobs, manufacturing jobs
UNCERTAINTIES
• Strain on infrastructure
• Childcare needs - what will that look like post-COVID?
• What will the endgame of COVID look like?
• Economic disparity increased by COVID
• Some of this uncertainty presents an opportunity to reimagine the City
• What will the path forward be for the Community Campus?
• How will we meet the expectations especially of new community members if there are fiscal constraints on the horizon?
• Need to address fire management, climate change, and urban fire interface. Also how climate change affects our water supplies.
• Concern about uncertainty of Bull Run water treatment needs.
© THE GROVE

2021-2023

Goals

Goal	Actions	Project Lead	Timeline
Plan and provide sustainable infrastructure	> Implement the next phase of the wastewater facilities plan and move forward with adequate funding	Public Works	Fall 2021
	> Complete the alternatives discharge including the analysis of constructed wetlands and incorporate into the Wastewater Facilities Plan	Public Works	Fall 2021
	> Continue progress on Bell Street/362nd road improvements	Public Works	Spring 2021
	> Evaluate our current water suppliers relationships and adopt Water Master Plan	Public Works	May 2021
	> Complete the transportation system plan and prioritize projects	Development Services	Ongoing with completion
	> Continue to grow SandyNet to make it self-sufficient for the long-term	SandyNet	Ongoing
	> Implement the transit master plan	Transit	Ongoing
Be proactive in managing and planning for growth	> Collaborate with the Planning Commission to develop policy and provide criteria for approving and/or recommending variances and zone changes	Development Services	Spring 2021
	> Begin the update of the City's Comprehensive Plan	Development Services	Summer 2021
	> Update the development code	Development Services	Ongoing, Various
Foster economic recovery and growth	> Develop a COVID-19 community recovery plan (i.e. business recovery, utility payment assistance plan, etc.)	Administration	Q2 2021
	> Develop a long-term plan for economic development that provides clear direction for commercial, industrial, small business growth	Economic Development	Q1 2022
Update Council policies and rules		City Council + Administration	Spring/Summer 2021

Goal	Actions	Project Lead	Timeline
Maintain financial strength and sustainability	> Diversify revenue sources, analyze new revenue streams, look at cost recovery where possible	Finance	Spring/Summer 2021
Collaborate with regional and community partners to address homelessness	> Appoint a homelessness task force	Administration/ Police	Spring 2021
	> Create a plan to address homelessness in Sandy	Administration/ Police	Winter 2022
Engage the community on community issues and in celebration	> Develop a strategy to engage and involve more people before decisions are made	Administration	Summer 2021
	> Celebrate Sandy's history and 110th anniversary	Community Services/Library	Summer 2021
Expand recreation opportunities that align with community needs	> Appoint a committee to guide the next steps for the Community Campus and aquatics	City Council	Winter 2021
	> Complete the parks and trails master plan	Community Services	Summer 2021
	> Develop a plan for the Community Campus	Community Services	Fall 2022
	> Explore Council and community recreation services needs and determine how the organization can support this	Community Services	Summer 2021-22
	> Incorporate biodiversity into our parks and green space	Community Services	Ongoing


CITY OF SANDY
COUNCIL GOALS
2021 - 2023
PLAN + PROVIDE SUSTAINABLE INFRASTRUCTURE
TSP
BE PROACTIVE IN MANAGING & PLANNING FOR GROWTH
DEVELOPMENT CODE
SANDY COMP PLAN
FOSTER ECONOMIC RECOVERY + GROWTH
UPDATE COUNCIL POLICIES + RULES
MAINTAIN FINANCIAL STRENGTH + SUSTAINABILITY
COLLABORATE WITH REGIONAL + COMMUNITY PARTNERS TO ADDRESS HOMELESSNESS
ENGAGE THE COMMUNITY ON COMMUNITY ISSUES + IN CELEBRATION
EXPAND RECREATION OPPORTUNITIES THAT ALIGN WITH COMMUNITY NEEDS
SGN CONSULTING 2021

Team Agreement

The Council agrees to:

Establish respectful and open communication channels

> We are committed to working as a team and will be open in our communications and provide honest feedback
> We respect everyone's ability to speak on an issue, but we will move forward as a team
> We agree to be thoughtful before making statements and be respectful of new and diverse perspectives
> We will provide clear and concise direction to staff

Stay focused on the goals and provide resources for implementation

> We will stay focused on our goals for the greater good of the Sandy community
> We will stay focused on the big picture and trust and empower staff to implement the goals
> We will support the goals and staff by providing sufficient resources to accomplish the work we've outlined
> Recognize that staff will be focused on the Council's goals and initiatives not on this list will not receive the same level of attention

Recognize our positive intentions to better our community

> We agree to be civil in our discussions and development of policy
> We honor differences of opinion and support the team even if we disagree

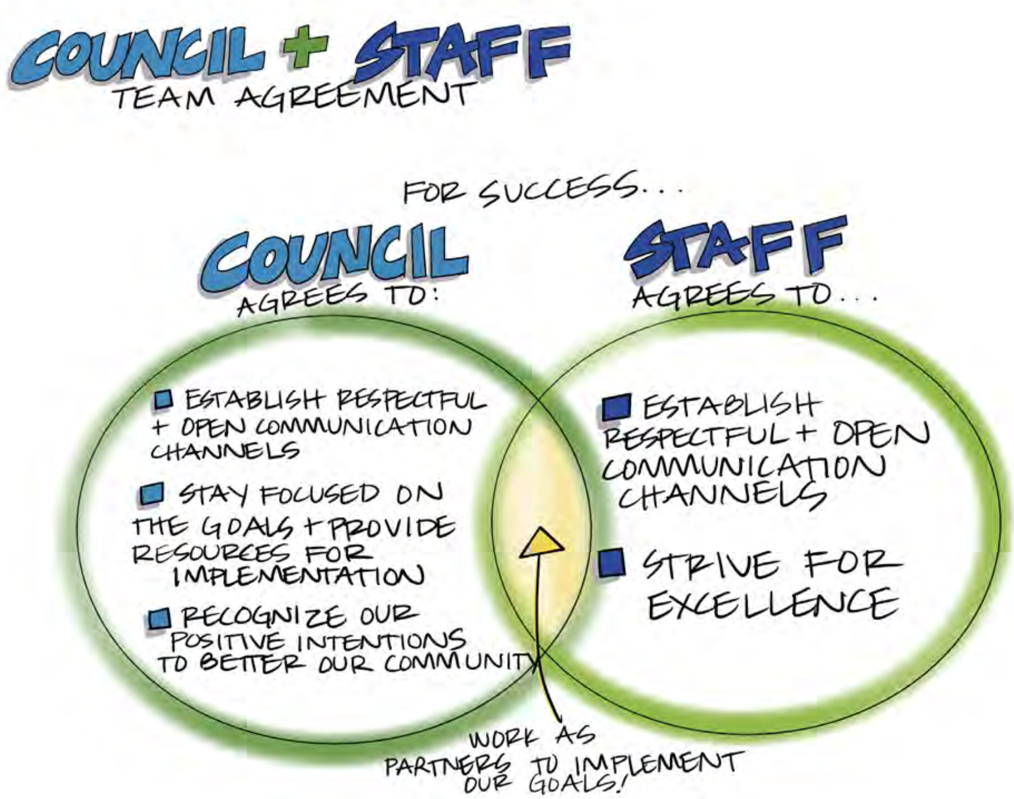
Staff agrees to:

Establish respectful and open communication channels

> Provide opportunities for Councilors to meet with the City Manager
> Present detailed information to the Council, help the team understand nuances of various topics, and be clear on what led to staff's recommendation
> No surprises. Be timely in sharing information and provide all of the details - good and bad so we can make decisions accordingly
> Keep the Council informed of staff's needs for guidance, resources, etc.
> Recognize the Council majority while maintaining and showing respect for the minority opinion

Strive for excellence

> Meet and exceed the high expectations of the Council and the community
> Always strive for better results



Prepared by:

SSW CONSULTING
www.sarasingerwilson.com