CLARE E. CONNORS 7936
Attorney General
State of Hawai‘i

STUART N. FUJIOKA 4223
RYAN W. ROYLO 6329
HOLLY T. SHIKADA 4017
Deputy Attorneys General
235 S. Beretania Street, Room 304
Honolulu, Hawai‘i 96813
Telephone: (808) 586-1255
Facsimile: (808) 586-1488

Email: Stuart.N.Fujioka@hawaii.gov
Ryan.W.Roylo@hawaii.gov
Melissa.J.Kolonie@hawaii.gov
Holly.T.Shikada@hawaii.gov

Attorneys for Petitioner
DEPARTMENT OF EDUCATION,
STATE OF HAWAI‘I

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI‘I

In the Matter of the Petition of DEPARTMENT OF EDUCATION, STATE OF HAWAI‘I, To Amend the Agricultural Land Use District Boundaries into the Urban Land Use District for Approximately 77.2 acres of land at Kihei, Maui, Hawai‘i, Maui Tax Map Key Nos. 2-2-02: 81 and 83.	DOCKET NO. A11-794 PETITIONER DEPARTMENT OF EDUCATION, STATE OF HAWAII’S UPDATE REGARDING ITS MOTION TO AMEND THE LAND USE COMMISSION’S FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER FILED JULY 29, 2013; EXHIBITS 10-18; CERTIFICATE OF SERVICE

PETITIONER DEPARTMENT OF EDUCATION, STATE OF HAWAII'S UPDATE REGARDING ITS MOTION TO AMEND THE LAND USE COMMISSION'S FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER FILED JULY 29, 2013

This report will serve to update the Land Use Commission (Commission) on the the Department of Education, State of Hawaii's (HIDOE) efforts to further address and resolve the issues raised in HIDOE's Motion to Amend the Land Use Commission's Findings of Fact, Conclusions of Law and Decision (FOF/COL) and Order Filed July 29, 2013 (Motion). As recommended by the Commission, HIDOE conducted a Webex conference with the Kihei Community Association (KCA) on October 27, 2020, to provide information regarding the construction (Project) of Kihei High School (School) and the proposed roundabout as well as to address KCA's concerns.

1. Updated Information

Prior to the meeting, HIDOE transmitted to representatives of KCA, the material attached hereto as Exhibits 10, 11 and 12. Representatives of KCA had questions about design and construction of the proposed School, which are outside the scope of the Motion. Representatives of HIDOE and representatives of KCA discussed the Motion, and unanimously agree that a roundabout is a viable, and perhaps the best and preferable available traffic safety and hazard mitigation measure. However, some representatives of KCA maintain that a Grade-Separated Pedestrian Crossing (GSPC) is also necessary to fully assure the safety of pedestrians who cross the highway for access to the School. It is HIDOE's hope that KCA is satisfied with a roundabout, at-grade raised crosswalks, HAWK traffic control system, and ongoing assessment of pedestrian safety measures to allow for the opening of the School upon the completion of Phase I of the Project;

however, KCA's spokesperson stated that he wished to further discuss the matter with the entire membership of KCA.

To update the record, Peititioners submit the following exhibits in corroboration of testimony presented by its witnesses at the hearing on September 10, 2020.

Exhibit 13 DOT's "Pedestrian Underpass Analysis Process"
Exhibit 14 As-built drawing of Kulanihakoi Bridge
Exhibit 15 FEMA flood map for Kulanihakoi Gulch
Exhibit 16 As-built drawing of Waipulani Bridge
Exhibit 17 Roundabout drawing
Exhibit 18 Speed survival rate chart

Petitioner also reports that it is not aware of any progress towards the establishment or funding of the recently-approved School Facilities Agency.

2. <u>Clarification of Petitioner's Position</u>

HIDOE has emphasized that in accordance with current Commission and Maui County requirements, pedestrian safety measures must be in place *before* the School can be opened. As the FOF/COL is currently written, a GSPC is required to allow crossing of Piilani Highway for access to the School campus. Since HIDOE, in consultation with the Department of Transportation (DOT), has found that an overpass or underpass would be underused and cost-prohibitive, that the recommended underpass locations present safety and topographical barriers, and that KCA has long been in support of a roundabout in the area, HIDOE is proposing to install a roundabout with at-grade raised crosswalks and HAWK traffic control system in the area of the School prior to its opening. As set forth in the Motion, HIDOE proposes that thereafter, at its expense, it shall conduct an assessment and reevaluation of the necessity, appropriateness, and utility of a GSPC prior to the start of the construction of Phase II of the Project.

There is no timetable for the start of Phase II, since it can be built only after a substantial increase in the School's anticipated student enrollment. However, to ensure that pedestrian safety is regularly and timely assessed, HIDOE is not seeking any amendment to the part of the FOF/COL which requires updates of the original Traffic Impact Analysis Report (TIAR).

> 1. Highway and Road Improvements. Petitioner will work cooperatively with DOT to reach mutually agreeable solutions. Petitioner shall abide by, complete and/or submit the following:
>
> a. …Petitioner shall submit three updated TIARs for the Project: the first one full year after opening of Phase I of the Project, the second with DOT approval prior to the issuance of any certificate of occupancy for Phase II of the Project, and the third with DOT approval one full year after full build out of Phase II of the Project. Should there be delays over three years between preparation of the updated TIAR one full year after opening of Phase I and the scheduled issuance of the certificate of occupancy for Phase II or any potential later Phasing, Petitioner shall submit an additional updated TIAR at DOT's request. All requirements and criteria for the TIAR and updated TIARs shall be agreed and approved by DOT. All project generated traffic shall be mitigated at Petitioner's expense as recommended or required in any of the TIARs approved by DOT. Petitioner shall submit copies of all TIARs and TIAR updates to the State of Hawai'i DOT for review and approval, and to the County of Maui Department of Public Works for review and comment.
>
> FOF/COL at p. 53.

As a result, if the School is opened with a roundabout, at-grade raised crosswalks, and HAWK traffic control system in place, the first update to the TIAR must be submitted within one year of said opening. This portion of the FOF/COL further requires that "all project generated traffic shall be mitigated at HIDOE's expense as recommended or required in any of the TIARs approved by DOT."

Then, prior to construction of Phase II, the necessity and feasibility of a GSPC must again be evaluated in accordance with HIDOE's current proposal, if its Motion is

granted. Under the language of the FOF/COL which remains in place, the TIAR must be updated again when Phase II is certified for occupancy. Yet another update to the TIAR is also required one year after build out of said Phase II.

Furthermore, under this condition, if more than three years should elapse between the first update (to be done one year after the school is opened), the DOT can request another update to the TIAR notwithstanding any construction, occupancy or planning as to Phase II.

3. <u>Proposed Resolution</u>

At the close of the October 27, 2020 Webex conference meeting with KCA, its representatives stated that they would discuss possible resolution of the pedestrian crossing issue with the rest of the KCA membership.

A summary of HIDOE's position is as follows.

a. Before the opening of the School, a roundabout with raised at-grade crosswalks and HAWK traffic control system, is to be built on Piilani Highway in front of the location of the School. Although the School will initially open without an underpass or overpass, the need for and feasibility of a GSPC will be revisited at least four times, two of which must occur within three years of the School's opening.

b. Per the FOF/COL, one year after the School opens, the TIAR will be updated.

c. The FOF/COL will be amended to require that prior to the start of construction of Phase II, HIDOE must conduct an assessment and reevaluation of the necessity, appropriateness, and utility of a GSPC.

d. As required under the FOF/COL, prior to a certificate of occupancy for Phase II or three years after the completion of Phase I and opening of the School, whichever is earlier, the TIAR will again be updated.

e. If a certificate of occupancy for Phase II is issued after an update to the TIAR which was required due to the lapse of three years, another update to the TIAR will be conducted in accordance with the FOF/COL as currently written.

f. The TIAR will again be updated one full year after the full build out of Phase II.

g. In accordance with the FOF/COL, all Project generated traffic shall be mitigated at HIDOE's expense as recommended or required in any of the TIARs approved by DOT.

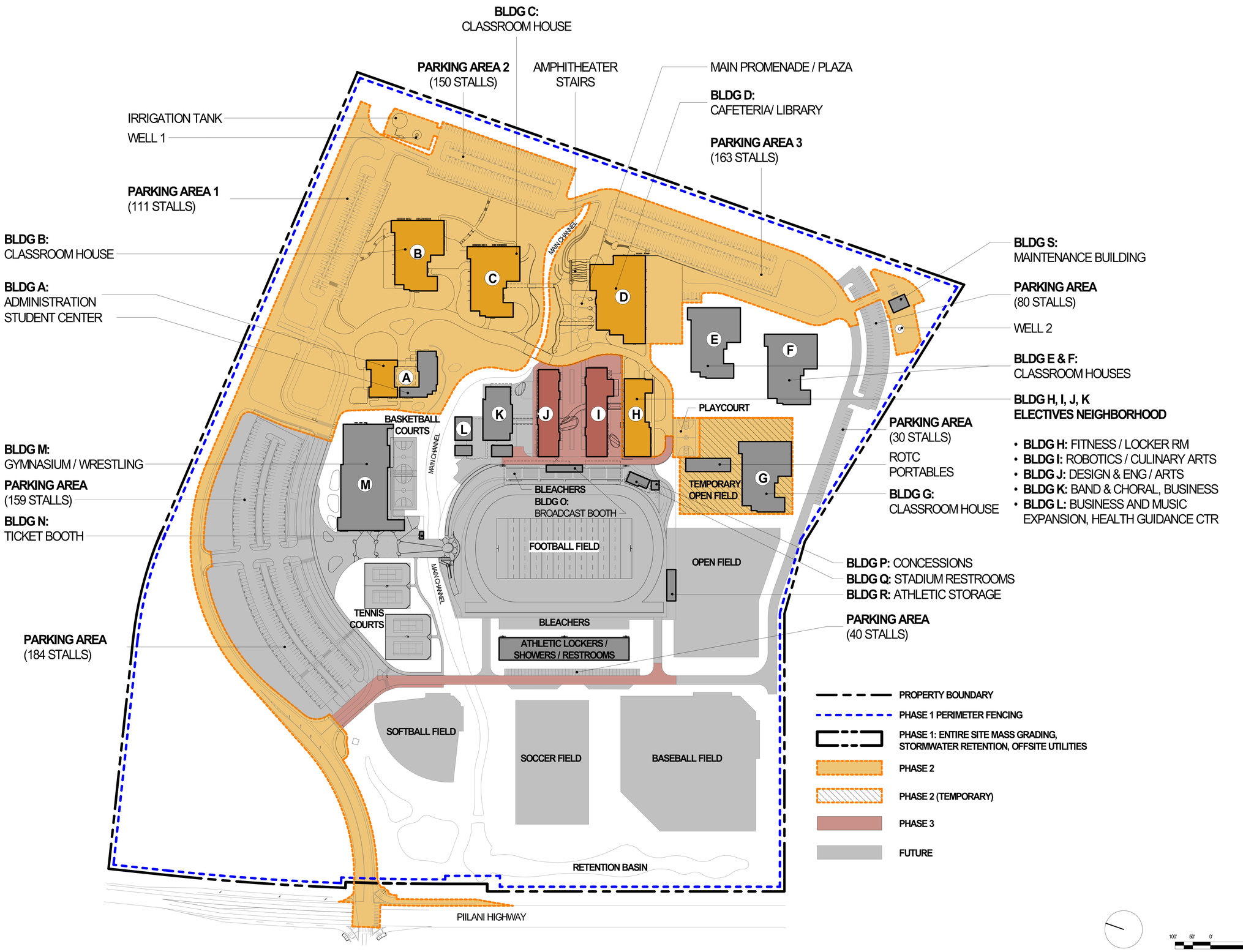
4. Current Status

HIDOE respectfully requests that the Commission grant its motion.

Dated: Honolulu, Hawai‘i, November 2, 2020.

/s/ Stuart N. Fujioka
STUART N. FUJIOKA
RYAN W. ROYLO
MELISSA J. KOLONIE
HOLLY T. SHIKADA
Deputy Attorneys General

Attorneys for Petitioner
DEPARTMENT OF EDUCATION,
STATE OF HAWAI‘I



- **BLDG H:** FITNESS / LOCKER RM
- **BLDG I:** ROBOTICS / CULINARY ARTS
- **BLDG J:** DESIGN & ENG / ARTS
- **BLDG K:** BAND & CHORAL, BUSINESS
- **BLDG L:** BUSINESS AND MUSIC EXPANSION, HEALTH GUIDANCE CTR

PHASING PLAN

KIHEI HIGH SCHOOL, NEW SCHOOL

10.06.2020

EXHIBIT 10

FEHR PEERS

TECHNICAL MEMORANDUM

Date: August 1, 2019

To: Craig Uemura, Ryan Char, and Kahealani Winchester – G70

From: Sohrab Rashid, Andrew Scher, and Cecily Taylor

Subject: Kihei High School – Multimodal Operations Alternatives Evaluation of the Kulanihakoi Street/Piilani Highway Intersection

LA19-2746.02

The State of Hawaii Department of Education (DOE) is in the process of designing and building a new high school in Kihei, Hawaii. Primary access to the new school will be provided via an extension of Kulanihakoi Street mauka of Piilani Highway. A key issue regarding site access is the means by which students walk to and from the school and cross the highway in the vicinity of the Kulanihakoi Street/Piilani Highway intersection. As part of the Land Use Commission review and environmental studies for the project, a grade-separated pedestrian crossing (GSPC) was to be considered by reviewing and approving agencies including the State of Hawaii Department of Transportation - Highways Division (DOT) and the County of Maui. An April 2017 transportation impact analysis report (TIAR) addendum study prepared by Fehr & Peers was conducted to determine if: 1) the proposed GSPC would be warranted based on Federal Highways Administration (FHWA) criteria and 2) a roundabout would be feasible as a traffic control device at the subject intersection based on planning level criteria and a preliminary multimodal assessment. The TIAR addendum concluded the following:

- a GSPC would not be warranted when the school opens with 800 students, and that a traffic signal would provide acceptable traffic operations with an at-grade pedestrian crossing of the highway in the near-term based on standard traffic operations analysis methods
- a GSPC could be warranted at some point in the future as the enrollment approaches 1,650 students and traffic volumes on the highway increase
- a roundabout would have to include at least a two-lane circulation roadway, would likely not accommodate long-term traffic volumes, and would also include operational and safety issues associated with at-grade pedestrian crossings of the multi-lane approach and departure lanes of the south intersection leg.

Subsequent to the April 2017 TIAR addendum, Fehr & Peers coordinated with DOT and ultimately recommended pedestrian treatments for this intersection in an August 3, 2018 letter. DOT approved the

EXHIBIT 11

TIAR addendum and associated documents in a letter dated October 26, 2018 (HWY-PS 2.8857) and concurred with the recommended treatments.

Earlier this year, the County of Maui indicated that the GSPC should be considered a mandatory requirement for the proposed high school development. To provide a more comprehensive detailed analysis of potential intersection design solutions, DOT requested that Fehr & Peers conduct an up-to-date operations and safety evaluation of the intersection over which it has jurisdiction. This new analysis used revised traffic volume forecasts, traffic simulation modeling, and a more thorough review of all travel modes. DOT requested that this study, which is presented in this technical memorandum, analyze the following three design alternatives for the intersection:

- Alternative 1 – Traffic signal with at-grade pedestrian crosswalks
- Alternative 2 – Traffic signal with a GSPC of the highway
- Alternative 3 – Roundabout with a GSPC of the highway

The purpose of the analysis is to determine how the alternatives would affect traffic operations and multi-modal circulation for two enrollments levels: 800 students in the opening year of 2021, and 1,650 students approximately 10 years later in 2031. The key findings and conclusions of this new study are presented below followed by the detailed technical analysis including the methodology and results.

Key Findings and Conclusions

Based on the traffic simulation modeling and multimodal circulation metrics evaluated in this report, the recommended intersection configuration option for buildout conditions of the high school in 2031 (1650 enrollment) is Alternative 2: Traffic Signal with a GSPC. This alternative minimizes the delay incurred by drivers (compared to the other alternatives) and provides a separate crossing of Piilani Highway for pedestrians, which enhances safety for active transportation travelers. Some less confident or experienced bicyclists may also choose to use the GSPC in lieu of the bicycle lanes planned for both sides of Kulanihakoi Street. Reducing driver delay minimizes driver frustration and reduces the potential for red light running, which is a hazard for pedestrians and bicyclists. By 2031, both Alternatives 1 and 3 are expected to result in substantially longer traffic delays and queues, and/or do not reduce the exposure of pedestrians to vehicle traffic. A more detailed engineering and feasibility analysis of the GSPC will need to be conducted if DOT determines that it is the appropriate design for this location.

Consistent with the FHWA-based warrant evaluation in the April 2017 TIAR Addendum, the GSPC would not be warranted from a traffic operations perspective in the near-term with the initial enrollment of 800 students in 2021. Installing an at-grade crossing at this location at the school opening would provide pedestrian facilities across the highway that are consistent with existing intersection layouts located north

and south of the site at the Ohukai Road and East Lipoa Street intersections, respectively. This configuration was previously approved for the near-term by DOT in their October 26, 2018 letter. The operations analysis shows that overall intersection level of service (LOS) with an at-grade pedestrian crossing at the Kulanihakoi Street intersection (i.e., Alternative 1) would exceed the desired operating level (LOS D) around Year 2025.

If an at-grade crossing is constructed initially in 2021 and then removed once a GSPC is constructed and opened for use, special treatments including barriers or fences plus regulatory signage should be installed to prohibit and deter pedestrians from trying to cross the highway at grade. Upon the initial opening of the GSPC and periodically afterwards, mandatory pedestrian safety instruction at the school and regular enforcement of the intersection should be used to discourage at-grade crossings.

Detailed Technical Analysis

Site Location and Context

The Kulanihakoi Street/Piilani Highway intersection is in the central area of Kihei, and no developed land uses are present on the mauka side of the highway near this intersection. As noted above, the new high school is located on the eastern side of Piilani Highway, and future access will be provided via a future mauka (i.e., eastern) leg of the intersection.

For the purposes of this study, the project design enrollment is 800 students by 2021 and 1,650 students by 2031. In addition to students driving or being driven to and from the school, some students will generate pedestrian trips at the intersection as they walk to and from the campus from the adjacent neighborhoods. Accordingly, multimodal operational and safety issues need to be addressed based on the intersection design.

Study Background

The original transportation impact analysis report (TIAR) for the new high school was originally completed in 2014 and was prepared by Wilson Okamoto & Associates. The TIAR included an analysis of various intersections and incorporated an assumption that the existing four-lane Piilani Highway would be widened to six lanes by 2028, which was the assumed buildout year for the high school. The findings of the 2014 study was used to inform the design of the Kulanihakoi Street/Piilani Highway intersection.

Fehr & Peers was subsequently retained to revise the TIAR and update it based on DOT comments, as well as to assist DOE and G70 with additional site planning and design issues. As part of this additional work, we revised the original signal warrant analysis (using Manual of Uniform Traffic Control Devices (MUTCD) criteria), conducted a preliminary assessment of a roundabout at the subject intersection, and prepared a pedestrian route study. The pedestrian route study identified included a Federal Highways Administration

(FHWA) warrant analysis for a grade-separated pedestrian crossing (GSPC), an assessment of potential crossing alternatives. The GSPC was identified as a required improvement by the State of Hawaii Land Use Commission (LUC), and the FHWA warrant study was completed to address the ultimate need and potential timing of this improvement. During the study, DOT staff indicated that no widening of the highway from four lanes to six lanes was anticipated for the foreseeable future. These evaluations were summarized in our Kihei High School TIAR Addendum dated April 27, 2017, and concluded that: 1) the GSPC would not be warranted until after the initial enrollment of 800 students was reached, and 2) a roundabout was not feasible from an operations perspective. Accordingly, design parameters were identified to accommodate the at-grade pedestrian crossing of the highway at Kulanihakoi Street including the size of median islands, anticipated traffic operations, etc.

In early 2019, DOT requested that an updated evaluation of potential design alternatives be conducted to determine the appropriate traffic control and pedestrian facilities at the Kulanihakoi Street/Piilani Highway intersection to serve the school. The three alternative intersection designs include:

1. Traffic signal with at-grade pedestrian crosswalks
2. Traffic signal with a grade-separated pedestrian crossing of the highway
3. Roundabout

The evaluation of each alternative was expected to include an analysis of traffic operations and an assessment of multimodal safety, specifically for vehicles, pedestrians and bicyclists. A detailed description of the design alternatives, the study methodology, and the evaluation of each option is presented below.

Description of Alternatives

Alternative 1: Traffic Signal with At-Grade Crosswalks

This alternative is a signalized intersection with at-grade pedestrian crossings on the west and south sides of the intersection. The existing number of northbound and southbound through lanes remains the same (two lanes each direction), and both the northbound and southbound approaches include dedicated left- and right-turn lanes. The eastbound approach has a shared through-left and shared through-right lane, while the westbound approach includes a left- turn lane and a shared through-right lane. All left-turn movements would be protected (or part of a split phase movement) to minimize conflicts with pedestrians). All right turns are channelized, providing pedestrian refuge islands which help to reduce uninterrupted exposure of pedestrians to vehicle traffic. A schematic illustration of this alternative is shown as **Figure 1** below.

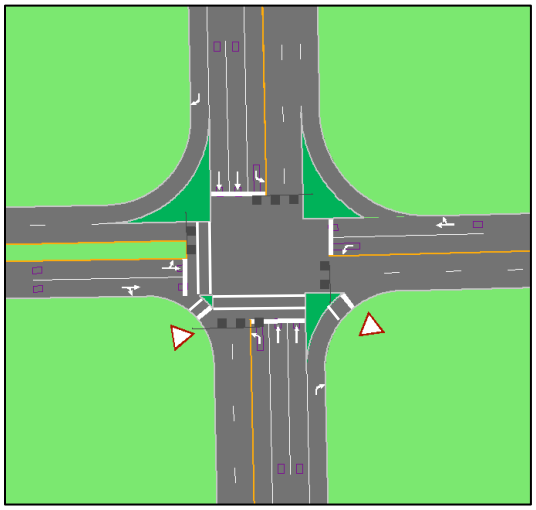


Figure 1: Alternative 1 - Signalized Intersection w At-Grade Pedestrian Crossings

Alternative 2: Traffic Signal with Grade-Separated Pedestrian Crossing

This alternative has the same intersection geometry as Alternative 1, but with no at grade pedestrian crossing of the highway. A grade separated pedestrian crossing (GSPC) would be built to accommodate pedestrians crossing Piilani Highway. An at-grade crosswalk would still be operated across the west (makai) leg of Kulanihakoi Street, but the northbound left-turn movement would be protected to avoid a conflict between left-turning vehicles and pedestrians in the Kulanihakoi Street crosswalk. The GSPC could be in the form of an overcrossing (i.e., a bridge) or an undercrossing (i.e., a tunnel).

Alternative 3: Roundabout with Grade-Separated Pedestrian Crossing

This alternative would reconfigure the intersection as a two-lane roundabout, with two lanes for the northbound and southbound approach and departure legs. Even the existing traffic volumes require a roundabout with two circulating lanes to provide appropriate vehicle capacity. The west and east legs would each include a single-lane approach and departure, with right-turn bypass movements to accommodate the higher right-turning volumes. For this evaluation, a GSPC is assumed to be in place for the Piilani Highway crossing. This assumption is based on two factors: 1) the results of the 2017 TIAR addendum showed that the projected long-term traffic volumes would exceed the capacity of the roundabout, and 2) pedestrians crossing the highway at-grade would have to cross two travel lanes on each approach and leg, resulting in a multi-threat condition. This condition occurs when one vehicle on the approach stops, but a vehicle driver in the adjacent lane does not see a pedestrian and proceeds through the crosswalk. For the Kulanihakoi Street leg, pedestrians would cross a single lane in each direction with a refuge area in between. A schematic illustration of this alternative is shown as **Figure 2** below.

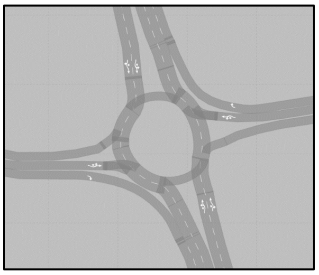


Figure 2: Alternative 3 - Roundabout Configuration

Conceptual layouts of each of these alternatives are shown in **Attachment A**. It should be noted that the Alternative 3 concept does not include the bypass lanes. Inclusion of these lanes would substantially increase the footprint of the roundabout and shift the center of the intersection further mauka.

Data Collection and Volume Development

Because of construction at and near the subject intersection in May of 2019, it was not possible to obtain new turning movement counts for this analysis. Accordingly, Year 2014 turning movement counts were obtained from the Kihei High School TIAR and adjusted to reflect future year conditions. The existing counts were obtained during the morning peak period (6 am to 9 am) and afternoon peak period (3 pm to 6 pm) on April 10th, 2014. Growth factors were developed using DOT historic volume data for Piilani Highway and adjacent facilities, and compared to anticipated growth traffic forecasts obtained from the Maui travel demand model developed by HDOT for use in the Maui County Long-Range Land Transportation Plan. The arithmetic average of these two data sources (1.7% per year) was applied to the 2014 volumes to develop 2021 and 2031 peak hour volumes for the study intersection without the proposed project.

Peak hour vehicle trips generated by the high school from the TIAR were then added to the baseline forecast volumes to calculate total AM and PM peak hour vehicle volumes with the project in place under 2021 and 2031 conditions. These volumes will dictate traffic operations under each of the alternatives, with additional influence caused by pedestrians that cross one or two intersection legs under each alternative. The traffic volumes used in this analysis are illustrated on **Figure 3**. It should be noted that these volumes are lower than those used in the original TIAR for the high school and the TIAR addendum prepared by Fehr & Peers. The original volumes assumed an extensive amount of traffic from approved and pending projects that would result in a growth rate that was not realistic over an extended period (e.g., 15 to 20 years).

Study Intersection | Traffic Signal | Roundabout | AM (PM) Peak Hour Traffic Volume | Lane/Movement Configuration

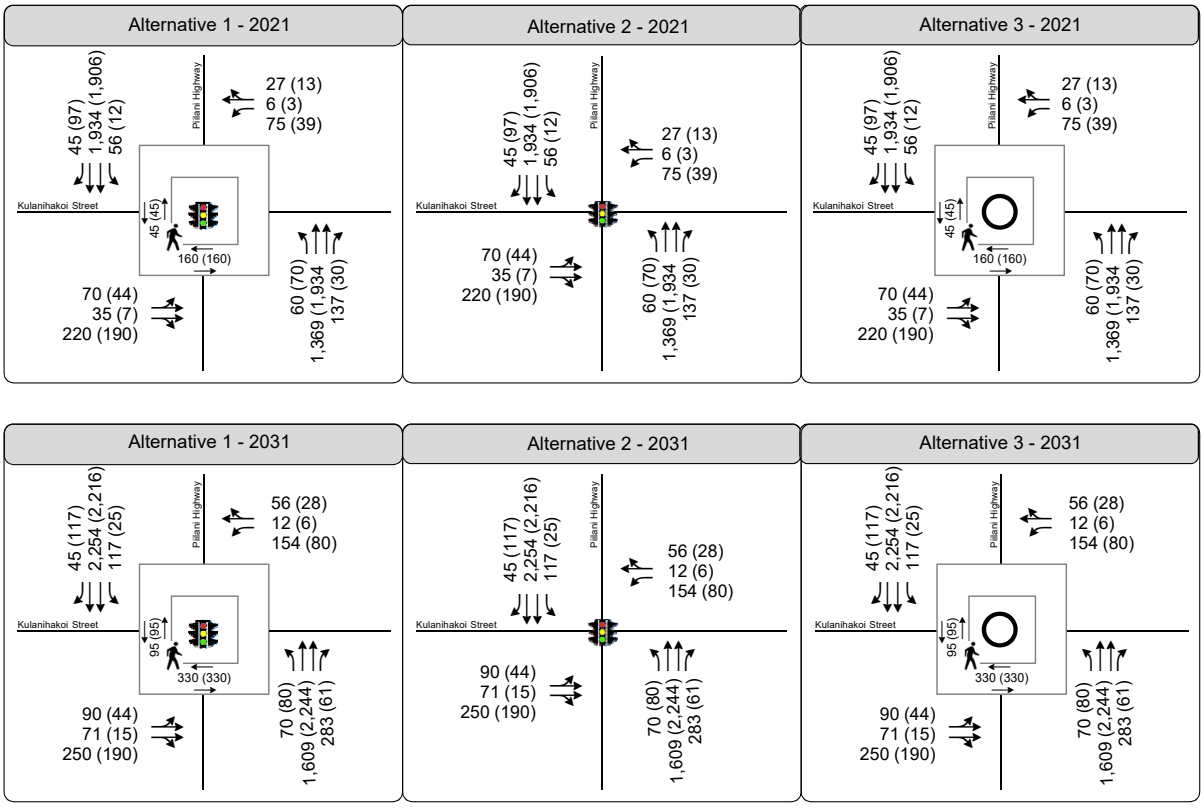


Figure 3

Year 2021 and 2031 Traffic and Pedestrian Volumes

Peak hour pedestrian volumes generated for the pedestrian route study were obtained from the 2017 TIAR Addendum. These volumes estimate that 20% of students will walk to school with 2/3 of this proportion (or a total of 220 students in 2031) arriving in the 20-minute period before classes start or immediately after they finish. Given an estimated cycle length of 180 seconds, this results in 16 and 33 pedestrians per signal cycle crossing the highway during each peak hour in 2021 and 2031, respectively. Based on a roughly equal distribution of homes north and south of the site makai of the highway, a total of 8 and 17 pedestrians per cycle per peak hour are estimated to cross the west leg of Kulanihakoi Street in 2021 and 2031, respectively. Detailed calculations for pedestrian volumes are included in **Attachment B** to this study. While it is possible that additional people may cross the highway at this location, the number of non-school-related pedestrians is expected to be negligible.

Regardless of the volumes, the pedestrian walk phase is expected to be activated by push button during nearly every cycle of the traffic signal in each peak hour where a signalized crosswalk is provided under Alternatives 1 and 2. The crosswalk across Kulanihakoi Street with the roundabout are not expected to be signalized.

Operations Analysis

Methodology

Due to the influence of concentrated pedestrian volumes forecast at the study intersection, traffic simulation was chosen to quantify vehicle operations. No existing conditions analysis was prepared since the proposed design alternatives would operate significantly differently from existing conditions.

SimTraffic 10.0 software was used to simulate future conditions for the signalized intersection options: Alternatives 1 and 2. A cycle length of 180 seconds was used, and the intersection splits were optimized since the closest signalized intersections are located more than 3,800 feet away and coordination would not be employed. The traffic micro-simulation software VISSIM was used to evaluate roundabout operations under Alternative 3 since: 1) SimTraffic is not able to accurately evaluate two-lane roundabouts, and 2) VISSIM includes extensive flexibility and capabilities for evaluating roundabout operations.

Because SimTraffic and VISSIM apply some randomness to the exact timing of vehicle arrival, 15 simulations were initially run for each study scenario (i.e., each alternative for each peak hour under 2021 and 2031 conditions). Of the 15 simulations, data outliers were removed until 10 simulations were identified as the most robust and reproducible, and the results of these 10 runs were averaged to calculate the final operations metrics, which include delay-based level of service (LOS) and vehicle queuing.

For each scenario, both the average vehicle delay by movement and the 95th percentile queue by approach were reviewed. While the 95th percentile queue is expected to happen extremely infrequently, this is a

standard convention for traffic analysis, and is expected to capture the worst-case condition over the peak hour.

Level of Service (LOS) is a term that describes the operating performance of an intersection or roadway. LOS is measured quantitatively and reported on a scale from A to F, with A representing the best performance and F the worst. **Table 1** provides a brief description of each LOS letter designation and an accompanying average delay per vehicle for both signalized and unsignalized intersections. The Highway Capacity Manual version 6 (HCM) methodology was used in this study to remain consistent with "state of the practice" professional standards. In general, HDOT strives to maintain minimum LOS D peak hour operations where feasible, understanding that some locations will operate at an undesirable level (E or F) where providing additional capacity is not physically or financially feasible.

Traffic Operations Results

Level of Service

A tabular comparison of each alternative's effect on vehicular LOS is presented in **Table 2**. Detailed operations result summaries are provided in **Attachment C.** As shown in **Table 2**, all three alternatives would result in a desirable intersection LOS through 2021 in the AM and PM peak hours. Operations are projected to be LOS C or better under both peak hours except for Alternative 3 (roundabout) in the AM peak hour, which would experience LOS D operations.

In 2031, however, Alternative 1 operations would degrade to LOS F in the AM peak hour and LOS E in the PM peak hour. Alternative 2 (with no pedestrians crossing the highway) would continue to operate at a desirable LOS during both peak hours. With a roundabout, the intersection would operate with substantial delay on multiple approaches and operate at an overall LOS F during both peak hours. As noted under the Alternative 3 description, the eastbound and westbound approaches would require right-turn bypass lanes to achieve the calculated delays and levels of service shown in Table 3. Without these bypass lanes, the delays would be higher.

TABLE 1: LEVEL OF SERVICE DEFINITIONS

LOS	Description	Signalized Intersections	Unsignalized Intersections
		Avg. Delay (sec/veh)[1]	Avg. Delay (sec/veh)[2]
A	*Free Flow / Insignificant Delay* Extremely favorable progression. Individual users are virtually unaffected by others in the traffic stream.	< 10.0	< 10.0
B	*Stable Operations / Minimum Delays* Good progression. The presence of other users in the traffic stream becomes noticeable.	> 10.0 to 20.0	> 10.0 to 15.0
C	*Stable Operations / Acceptable Delays* Fair progression. The operation of individual users is affected by interactions with others in the traffic stream	> 20.0 to 35.0	> 15.0 to 25.0
D	*Approaching Unstable Flows / Tolerable Delays* Marginal progression. Operating conditions are noticeably more constrained.	> 35.0 to 55.0	> 25.0 to 35.0
E	*Unstable Operations / Significant Delays Can Occur* Poor progression. Operating conditions are at or near capacity.	> 55.0 to 80.0	> 35.0 to 50.0
F	*Forced, Unpredictable Flows / Excessive Delays* Unacceptable progression with forced or breakdown of operating conditions.	> 80.0	> 50.0

1. Overall intersection LOS and average delay (seconds/vehicle) for all approaches.
2. Worst approach LOS and delay (seconds/vehicle) only. Applies to stop sign and roundabout controlled locations.

Source: Fehr & Peers descriptions, based on *Highway Capacity Manual, Version 6*.

TABLE 2: PEAK HOUR INTERSECTION LEVEL OF SERVICE BY ALTERNATIVE

Study Scenario at Piilani Hwy/Kulanihakoi St	Intersection Configuration					
	Alternative 1 Traffic Signal w/ At-Grade Crossing		Alternative 2 Traffic Signal w/ GSPC		Alternative 3 Roundabout w/ GSPC	
	Delay	LOS	Delay	LOS	Delay	LOS
AM Peak Hour						
Year 2021	33.1	C	25.8	C	25.8	D
Year 2031	**86.0**	**F**	52.8	D	**83.3**	**F**
PM Peak Hour						
Year 2021	26.4	C	18.2	B	14.2	B
Year 2031	**58.5**	**E**	30.1	C	**77.3**	**F**

Notes: **Bold** font indicates undesirable operations .
Source: Fehr & Peers, 2019.

Consistent with the previous DOT approval, one potential scenario for phasing pedestrian crossing access is to initially provide an at-grade crossing under Alternative 1, and construct a GSPC under Alternative 2 at some later date when traffic operations deteriorate to undesirable levels. As noted in the previous section, LOS D with a maximum delay of 55.0 seconds is the operating level that DOT strives to maintain. Using linear interpolation between the 2021 and 2031 delays of 33.1 and 86.0, respectively, the traffic operations of Alternative 1 are expected to reach the LOS D maximum delay of 55 seconds by Year 2025. This result is one consideration for determining an appropriate time to construct the GSPC under Alternative 2.

Vehicle Queuing

Another traffic operations metric that illustrates the level of congestion is the length of vehicle queues at an intersection. A comparison of each alternative's effect on 95th percentile vehicle queuing is presented in **Table 3**. For this metric, this is the maximum vehicle length that is expected to occur 95% of the time. Detailed operations result summaries are provided in **Attachment D.**

Through 2021, the projected 95th percentile queues under Alternatives 1 and 2 are similar during the AM and PM peak hours with the longest queues calculated for the southbound movement (600 to 700 feet or 24 to 28 vehicles – using an average queue length of 25 feet per vehicle). Under Alternative 3, projected AM peak hour queues are expected to be similar to Alternatives 1 and 2 on the highway approaches, but longer on the eastbound and westbound approaches of Kulanihakoi Street. During the PM peak hour, the Alternative 3 queues would be longer than Alternatives 1 and 2 on the northbound, southbound, and westbound approaches, with nearly double the queue of Alternative 2 on the northbound approach.

By 2031 with an enrollment of 1,650 students at Kihei High School, selected vehicle queues under Alternative 1 with an at-grade crossing would nearly double in length or more compared to Year 2021 queues. The southbound movement would experience the longest queues at roughly 2,300 feet and 1,500 feet during the AM and PM peak hours, respectively. Alternative 2 would also see queue increases between 2021 and 2031, but not nearly to the same level with the longest queue for the southbound highway of 1,330 feet. Under Alternative 2, all the remaining queues would be 750 feet or less. With a roundabout and GSPC in 2031 under Alternative 3, the 95th percentile vehicle queues in both directions of the highway would be in excess of 1,000 feet, with some longer and some shorter than queues expected for Alternatives 1 and 2. Part of the reason for the longer queues is the imbalance of volumes at the intersection across the various approach legs.

TABLE 3: PEAK HOUR VEHICLE QUEUES BY ALTERNATIVE

Study Scenario at Piilani Hwy/Kulanihakoi St	Movement	95th Percentile Queue (feet)		
		Alternative 1 Traffic Signal w/At-Grade Crossing	Alternative 2 Traffic Signal w/ GSPC	Alternative 3 Roundabout w/ GSPC
AM Peak Hour				
Year 2021	NB	430	400	377
	SB	700	610	655
	EB	270	290	419
	WB	40	40	109
Year 2031	NB	740	530	1,228
	SB	2,280	1,330	1,122
	EB	360	410	334
	WB	230	290	360
PM Peak Hour				
Year 2021	NB	540	390	772
	SB	610	530	664
	EB	200	200	139
	WB	30	30	122
Year 2031	NB	910	550	1,043
	SB	1,500	750	1,130
	EB	240	230	426
	WB	40	40	361

Source: Fehr & Peers, 2019

Multimodal Circulation and Safety Assessment

Under each alternative, pedestrian and bicycle circulation was assessed based on the proposed circulation paths, potential conflicts with vehicles, and other potential safety issues. In addition, the alternatives were assessed in terms of vehicle collision type and severity. The results of this preliminary assessment, along with a summary of vehicle operations is presented in **Table 4** on the following page. The last column in this table also includes Other Considerations regarding each alternative.

Attachments:

- Attachment A: Alternative Conceptual Designs
- Attachment B: Pedestrian Volume Estimate
- Attachment C: Intersection Level of Service Calculation Worksheets
- Attachment D: Detailed Queuing Results

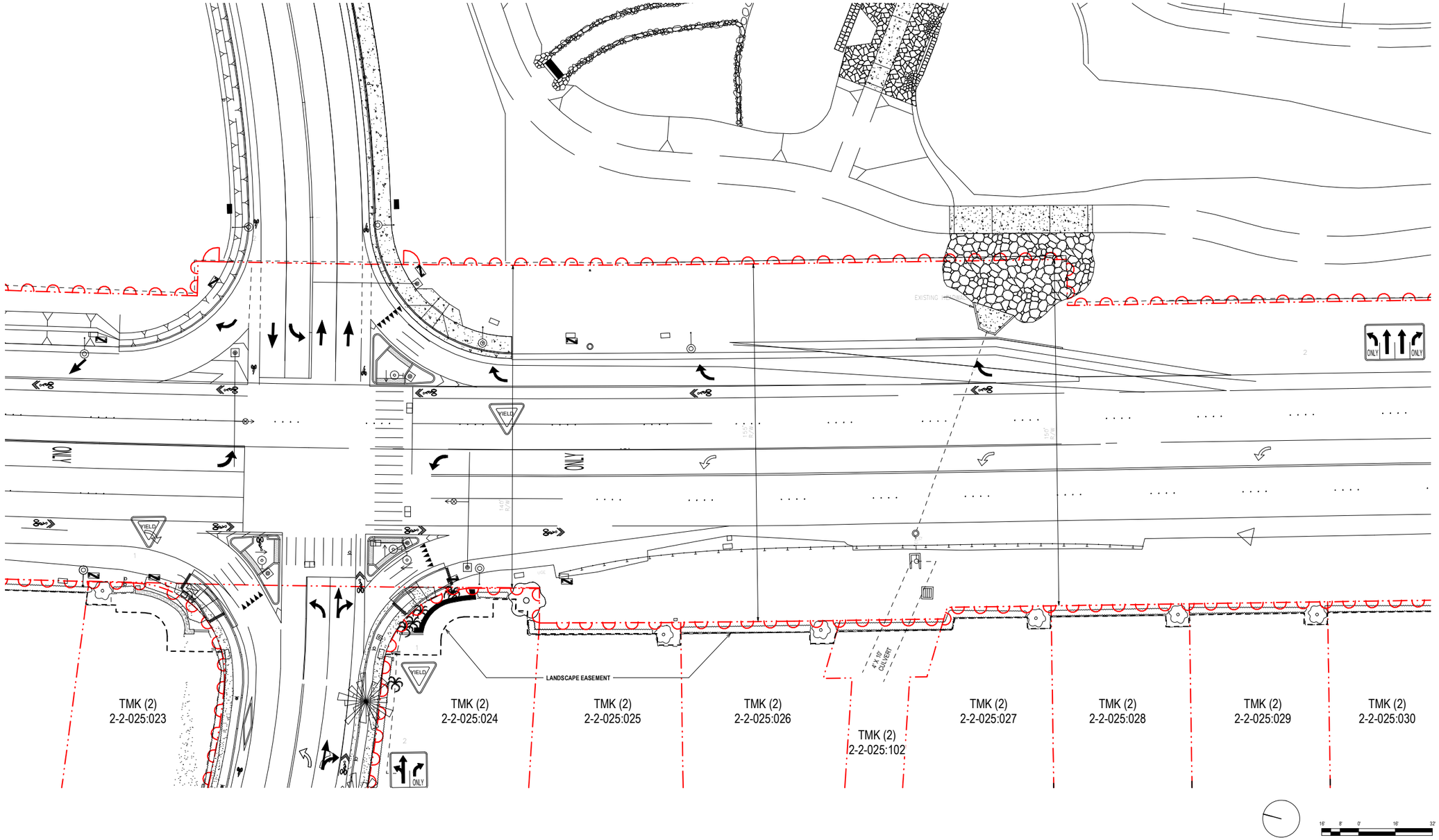
TABLE 4: VEHICLE OPERATIONS AND MULTIMODAL CIRCULATION ASSESSMENT SUMMARY

Description	Intersection Level of Service (2031)	Traffic Operations Issues (2031)	Pedestrian Circulation	Bicycle Circulation	Vehicle Collisions	Other Considerations
1. Traffic Signal w/ At-Grade Pedestrian Crossing	AM Peak Hour: LOS F PM Peak Hour: LOS E Summary: With more time needed to be allocated to east-west pedestrian crossing than is needed for eastbound vehicles, delay and queue lengths are worsened on the northbound and southbound approaches.	95th percentile southbound queue lengths would exceed 2,200 feet and 1,500 feet in the AM and PM peak hours, respectively. 95th percentile northbound queue lengths would exceed 900 feet during the PM peak hour. Ped phases would affect all signal phases.	Pedestrians exposed to vehicles across highway lanes and across 2 or 3 channelized right-turn lanes. However, WB left-turn signal phasing would be protected on Kulanihakoi Street so that no vehicle conflicts should occur.	Bicyclists would use striped bicycle lanes and traffic signals to travel across the highway. Bicyclists would travel next to vehicles but in a separate space adjacent to the vehicle lane.	Typical expectation for vehicle collisions (e.g., rear-end, head-on, broadside) depending on driver adherence to signal indications. Typical conflicts with pedestrians expected at a signalized intersection.	Current intersection design as of June 2019 is Alternative 1.
2. Traffic Signal w/ Grade-Separated Pedestrian Crossing	AM Peak Hour: LOS D PM Peak Hour: LOS C Summary: With longer northbound and southbound phases, less delay and shorter queues would occur on the Piilani Hwy approaches.	95th percentile southbound queue would exceed 1,300 feet during the AM peak hour, which is roughly 40% shorter than Alternative 1. Similarly, the PM peak southbound queue would be 50% shorter than Alternative 1.	Pedestrians only exposed to vehicles crossing Kulanihakoi Street makai approach (three lanes total) including 2 channelized right-turn lanes.	Same as Alternative 1 except that less confident bicyclists could use the GSPC to cross the highway by walking or riding their bike.	Typical expectation for vehicle collisions (e.g., rear-end, head-on, broadside) depending on driver adherence to signal indications. Reduced conflicts with pedestrians compared to Alternative 1 with no pedestrian crossing of highway.	GSPC must be ADA-compliant and should be available once a legal highway crossing is provided (i.e., prior to the opening of the school).
3. Two-Lane Roundabout w/ Grade-Separated Pedestrian Crossing	AM Peak Hour: LOS F PM Peak Hour: LOS F Summary: Roundabouts reduce vehicle speeds and the subsequent capacity for the northbound and southbound approaches is greatly reduced, resulting in lengthy delays.	95th percentile highway queues would range from roughly 1,000 to 1,200 feet during each peak hour. All but one highway queue would be longer than Alternative 2. Vehicles would have to stop for pedestrians on the makai Kulanihakoi Street approach and departure leg where at-grade crossings would be permitted.	Pedestrians only exposed to vehicles crossing Kulanihakoi Street makai approach (one lane in each direction) plus crossings of 2 channelized right-turn lanes.	Bicycles would: 1) circulate through the roundabout and share the roadway with vehicles, or 2) use designated ramps to access the sidewalk and use the same crosswalk and/or GSPC as pedestrians while walking their bicycle. This latter option is less desirable because it requires bicyclists to dismount.	Severe vehicle collisions (e.g., head-on, broadside) would be expected much less frequently where sideswipe or rear-end collisions are more prevalent with the one-way circulating pattern.	Same as Alternative 2 plus additional right-of-way needed to accommodate design of 150-foot minimum diameter roundabout. Right-turn bypass lanes would require shift of intersection location.

Source: Fehr & Peers, 2019

LEGEND: Comparative benefit: Least benefit Moderate benefit Most benefit

Attachment A – Conceptual Intersection Designs

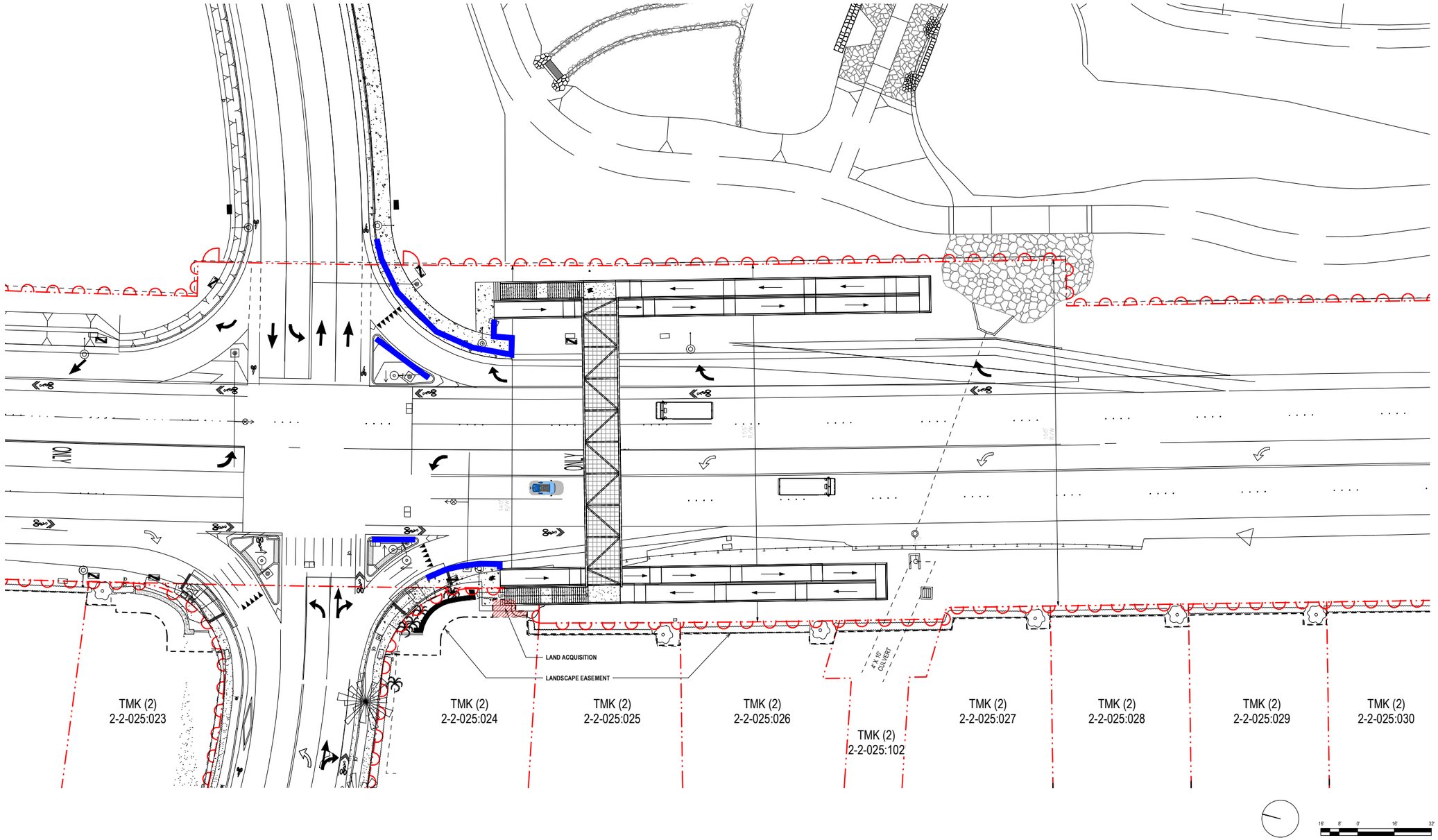


KIHEI HIGH SCHOOL - PHASE 2 INTERSECTION PLAN | A-1

KIHEI HIGH SCHOOL | 3/04/19

Alternative 1 - Traffic Signal w/ At-Grade Pedestrian Crossings

= Potential Barrier Locations

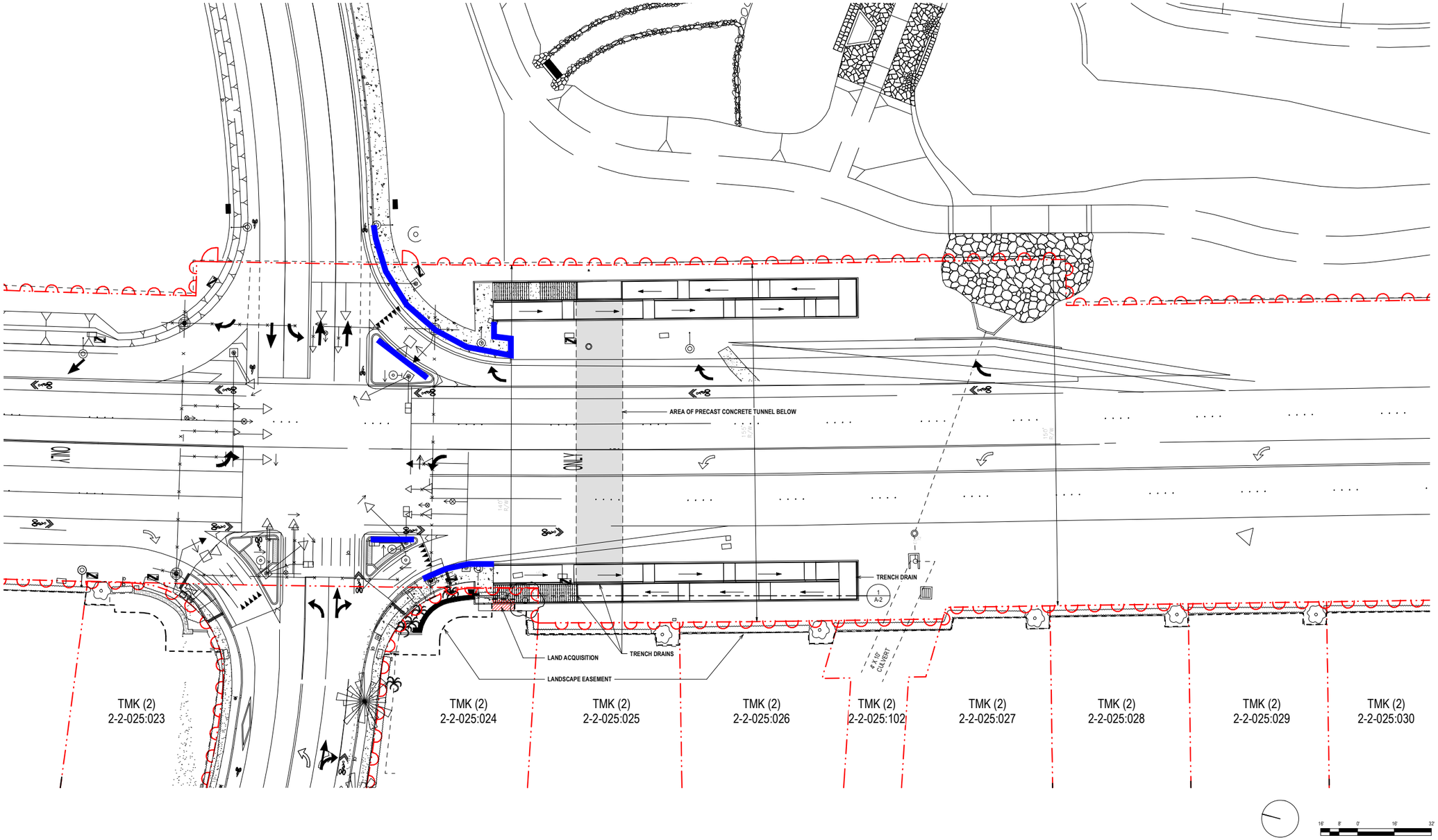


GRADE-SEPARATED PEDESTRIAN CROSSING - OVERPASS CONCEPT - SITE PLAN | A-1

KIHEI HIGH SCHOOL | 3/04/19

Alternative 2 - Traffic Signal w/ Grade-Separated Pedestrian Crossing Over Highway (Overpass)

= Potential Barrier Locations



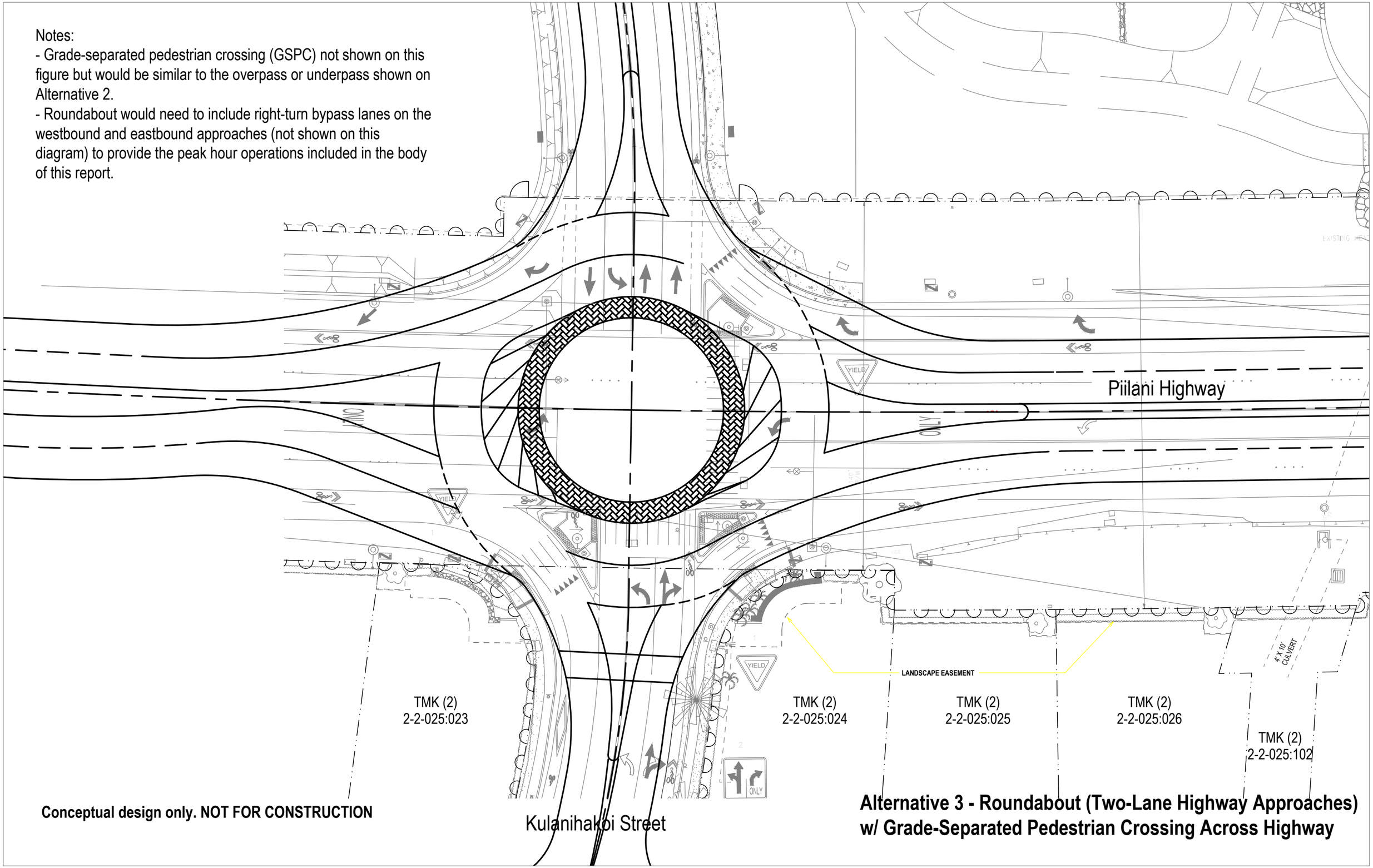
GRADE-SEPARATED PEDESTRIAN CROSSING - UNDERPASS CONCEPT - SITE PLAN | A-1

KIHEI HIGH SCHOOL | 3/04/19

Alternative 2 - Traffic Signal w/ Grade-Separated Pedestrian Crossing Over Highway (Underpass)

3/18/2019 8:12:42 AM P:\2008\28911-07 Kihei High School Design\roadd\rv\central\Kihei Pedestrian Underpass_A1B.rvt

Notes:
- Grade-separated pedestrian crossing (GSPC) not shown on this figure but would be similar to the overpass or underpass shown on Alternative 2.
- Roundabout would need to include right-turn bypass lanes on the westbound and eastbound approaches (not shown on this diagram) to provide the peak hour operations included in the body of this report.



Conceptual design only. NOT FOR CONSTRUCTION

Alternative 3 - Roundabout (Two-Lane Highway Approaches) w/ Grade-Separated Pedestrian Crossing Across Highway

Attachment B – Growth Factor Calculation

ATTACHMENT B - GROWTH FACTOR

Model Estimates - recent version updated for land uses for Waikapu Country Town project)

	2020	2035
Piilani Hwy - N of Kaonoulu St	45,242.20	49,933.99
Piilani Hwy - Kulani Hakoi St to Kaonoulu St	43,872.93	52,966.97
Piilani Hwy - E Waipuilani Rd to Kulani Hakoi St	43,837.88	52,185.32
Piilani Hwy - S of E Waipuilani Rd	41,634.07	48,880.63
Sum of links	**174,587.08**	**203,966.90**
% Growth		**1.0%**

Historic Counts

	2013	2014	2015	2016	2017
Piilani Hwy - Lipoa St to Welakahao Rd	33,195.0	33,391.0	34,830.0	35,476.0	37,991.0
Kulanihakoi St - Oluea St to S Kihei Rd	2,728.0	2,465.0	2,216.0	2,680.5	2,167.5
Sum of links	**35,923.0**	**35,856.0**	**37,046.0**	**38,156.5**	**40,158.5**
% Growth since 2013				**2.0%**	**2.8%**

Growth Factor Calculation

Model Estimate:	1.0%
Historic Estimate:	2.4%
Applied:	**1.7%**

Attachment C – Intersection LOS Calculation Worksheets

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 no peds**
Network Performance **AM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	32.4	1.1	30.8	33.9
Total Delay (hours)	34	2	32	37
Average Stopped Delay (seconds)	16.1	1.0	14.7	17.9
Total Stopped Delay (hours)	17	1	15	20
Total Stops	1,572	37	1,515	1,646
Average Stops	0.41	0.01	0.40	0.42
Total Distance Traveled (miles)	3,563	57	3,472	3,643
Average Speed (mph)	27.4	0.5	27.0	28.0
Total Travel Time (hours)	130.4	3.2	125.7	135.4
Vehicles Entered	3,687	58	3,603	3,778
Vehicles Exited	3,684	61	3,598	3,782
Percent Demand Served	99.9%	0.4%	99.2%	100.4%
Fuel Used (gallons)	99	2	95	102
HC Emissions (grams)	1,303	70	1,215	1,401
CO Emissions (grams)	35,224	1,246	33,520	37,177
NOx Emissions (grams)	4,915	203	4,636	5,193

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 no peds**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	60	59	99.0%	91.5	27.5	F
	Through	1,369	1,340	97.9%	14.9	1.8	B
	Right Turn	137	133	97.3%	4.6	0.7	A
	Subtotal	1,566	1,533	97.9%	16.7	2.5	B
SB	Left Turn	56	56	100.3%	80.0	9.2	F
	Through	1,934	1,907	98.6%	27.0	3.5	C
	Right Turn	45	46	103.1%	14.0	3.7	B
	Subtotal	2,035	2,009	98.7%	28.2	3.5	C
EB	Left Turn	70	74	105.5%	61.6	7.6	E
	Through	35	34	98.3%	67.5	20.4	E
	Right Turn	220	221	100.3%	33.2	12.1	C
	Subtotal	325	329	101.2%	42.6	10.3	D
WB	Left Turn	75	80	106.0%	80.0	20.3	F
	Through	6	7	117.5%	55.5	49.2	E
	Right Turn	27	29	107.0%	1.1	0.2	A
	Subtotal	108	115	106.9%	57.2	17.3	E
Total		4,034	3,986	98.8%	25.8	2.8	C

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 w peds**
Network Performance **AM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	39.2	1.6	37.4	42.0
Total Delay (hours)	42	2	40	45
Average Stopped Delay (seconds)	20.5	1.4	18.2	23.0
Total Stopped Delay (hours)	22	2	20	25
Total Stops	1,830	78	1,742	1,988
Average Stops	0.48	0.02	0.45	0.50
Total Distance Traveled (miles)	3,586	63	3,492	3,687
Average Speed (mph)	25.9	0.3	25.0	26.0
Total Travel Time (hours)	138.6	3.5	134.6	144.6
Vehicles Entered	3,713	59	3,627	3,820
Vehicles Exited	3,715	66	3,621	3,808
Percent Demand Served	100.1%	0.6%	99.3%	101.1%
Fuel Used (gallons)	102	2	98	105
HC Emissions (grams)	1,363	100	1,245	1,510
CO Emissions (grams)	36,332	1,761	34,260	38,942
NOx Emissions (grams)	5,087	268	4,780	5,472

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 w peds**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	60	59	98.9%	193.6	77.9	F
	Through	1,369	1,348	98.4%	20.3	2.0	C
	Right Turn	137	137	100.0%	6.1	1.8	A
	Subtotal	1,566	1,544	98.6%	25.0	3.5	C
SB	Left Turn	56	59	104.7%	84.7	12.6	F
	Through	1,934	1,894	97.9%	35.1	5.4	D
	Right Turn	45	44	98.8%	18.3	3.7	B
	Subtotal	2,035	1,997	98.1%	36.1	5.1	D
EB	Left Turn	70	74	105.1%	59.5	8.6	E
	Through	35	35	100.9%	61.1	14.7	E
	Right Turn	220	229	104.1%	30.3	9.8	C
	Subtotal	325	338	104.0%	41.1	6.7	D
WB	Left Turn	75	80	106.8%	88.7	26.8	F
	Through	6	7	116.7%	61.3	54.2	E
	Right Turn	27	25	93.7%	1.3	0.3	A
	Subtotal	108	112	104.1%	66.3	18.6	E
Total		4,034	3,991	98.9%	33.1	2.8	C

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 no peds**
Network Performance **PM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	27.0	0.9	25.8	28.2
Total Delay (hours)	34	2	32	36
Average Stopped Delay (seconds)	8.8	0.4	8.2	9.5
Total Stopped Delay (hours)	11	0	10	12
Total Stops	1,288	49	1,240	1,383
Average Stops	0.28	0.01	0.27	0.30
Total Distance Traveled (miles)	5,610	94	5,483	5,745
Average Speed (mph)	31.0	0.0	31.0	31.0
Total Travel Time (hours)	182.2	3.9	177.0	187.9
Vehicles Entered	4,353	70	4,245	4,454
Vehicles Exited	4,357	71	4,267	4,460
Percent Demand Served	100.1%	0.5%	99.3%	100.8%
Fuel Used (gallons)	167	4	163	173
HC Emissions (grams)	1,679	103	1,469	1,831
CO Emissions (grams)	44,352	1,998	41,034	47,796
NOx Emissions (grams)	6,598	305	6,025	7,083

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 no peds**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	71	100.7%	78.1	14.9	E
	Through	1,934	1,929	99.8%	12.6	1.4	B
	Right Turn	30	29	97.0%	8.8	2.2	A
	Subtotal	2,034	2,029	99.7%	15.0	1.7	B
SB	Left Turn	12	11	95.0%	84.6	35.3	F
	Through	1,906	1,926	101.1%	19.7	2.9	B
	Right Turn	97	93	95.8%	9.7	2.1	A
	Subtotal	2,015	2,030	100.8%	19.7	2.7	B
EB	Left Turn	44	45	103.2%	56.0	17.2	E
	Through	7	8	111.4%	71.8	46.2	E
	Right Turn	190	188	99.1%	13.8	7.2	B
	Subtotal	241	241	100.2%	24.1	6.5	C
WB	Left Turn	39	38	96.2%	64.7	19.8	E
	Through	3	3	103.3%	52.1	54.6	D
	Right Turn	13	13	103.1%	1.3	0.2	A
	Subtotal	55	54	98.2%	49.9	15.4	D
Total		4,345	4,355	100.2%	18.2	1.9	B

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2021 w peds**
Network Performance **PM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	27.0	0.9	25.8	28.2
Total Delay (hours)	34	2	32	36
Average Stopped Delay (seconds)	8.8	0.4	8.2	9.5
Total Stopped Delay (hours)	11	0	10	12
Total Stops	1,288	49	1,240	1,383
Average Stops	0.28	0.01	0.27	0.30
Total Distance Traveled (miles)	5,610	94	5,483	5,745
Average Speed (mph)	31.0	0.0	31.0	31.0
Total Travel Time (hours)	182.2	3.9	177.0	187.9
Vehicles Entered	4,353	70	4,245	4,454
Vehicles Exited	4,357	71	4,267	4,460
Percent Demand Served	100.1%	0.5%	99.3%	100.8%
Fuel Used (gallons)	167	4	163	173
HC Emissions (grams)	1,679	103	1,469	1,831
CO Emissions (grams)	44,352	1,998	41,034	47,796
NOx Emissions (grams)	6,598	305	6,025	7,083

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	70	99.6%	139.1	41.7	F
	Through	1,934	1,906	98.6%	20.3	2.8	C
	Right Turn	30	29	95.7%	12.6	4.4	B
	Subtotal	2,034	2,005	98.6%	24.6	3.5	C
SB	Left Turn	12	13	106.7%	71.8	17.6	E
	Through	1,906	1,895	99.4%	28.5	4.5	C
	Right Turn	97	96	99.3%	12.4	2.5	B
	Subtotal	2,015	2,004	99.4%	28.0	4.5	C
EB	Left Turn	44	41	92.3%	57.7	14.9	E
	Through	7	7	92.9%	38.7	47.9	D
	Right Turn	190	192	101.3%	13.2	7.1	B
	Subtotal	241	240	99.4%	21.5	7.2	C
WB	Left Turn	39	37	93.8%	61.8	23.4	E
	Through	3	4	130.0%	43.0	34.4	D
	Right Turn	13	13	99.2%	1.4	0.7	A
	Subtotal	55	53	97.1%	43.4	16.0	D
Total		4,345	4,301	99.0%	26.4	3.1	C

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 no peds**
Network Performance **AM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	61.2	7.1	51.9	70.3
Total Delay (hours)	81	10	69	94
Average Stopped Delay (seconds)	33.1	5.1	26.4	43.4
Total Stopped Delay (hours)	44	7	35	58
Total Stops	3,141	320	2,740	3,659
Average Stops	0.66	0.06	0.57	0.76
Total Distance Traveled (miles)	4,360	43	4,290	4,449
Average Speed (mph)	21.8	1.0	20.0	23.0
Total Travel Time (hours)	201.3	10.6	189.6	214.1
Vehicles Entered	4,597	48	4,512	4,679
Vehicles Exited	4,580	47	4,518	4,682
Percent Demand Served	99.6%	0.6%	98.7%	100.4%
Fuel Used (gallons)	131	2	128	135
HC Emissions (grams)	1,623	89	1,489	1,794
CO Emissions (grams)	43,557	1,425	41,531	46,200
NOx Emissions (grams)	6,002	217	5,703	6,456

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 no peds**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	62	88.2%	370.1	122.7	F
	Through	1,609	1,537	95.5%	33.7	29.3	C
	Right Turn	283	283	99.8%	16.6	23.1	B
	Subtotal	1,962	1,882	95.9%	41.9	30.4	D
SB	Left Turn	117	118	100.5%	197.6	43.0	F
	Through	2,254	2,130	94.5%	123.6	22.9	F
	Right Turn	45	45	99.7%	107.5	23.5	F
	Subtotal	2,416	2,293	94.9%	127.0	22.0	F
EB	Left Turn	90	85	94.1%	55.8	8.0	E
	Through	71	79	110.9%	62.0	11.0	E
	Right Turn	250	251	100.3%	44.7	13.8	D
	Subtotal	411	414	100.8%	50.1	9.0	D
WB	Left Turn	154	160	103.7%	107.1	41.5	F
	Through	12	10	85.4%	115.9	42.4	F
	Right Turn	56	57	101.3%	52.6	45.5	D
	Subtotal	222	227	102.1%	93.7	44.4	F
Total		5,011	4,815	96.1%	86.0	10.6	F

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 w peds**
Network Performance **AM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	86.9	6.7	76.1	95.0
Total Delay (hours)	115	9	99	124
Average Stopped Delay (seconds)	49.3	6.8	41.9	65.0
Total Stopped Delay (hours)	65	9	54	84
Total Stops	4,312	339	3,815	4,751
Average Stops	0.91	0.07	0.82	1.00
Total Distance Traveled (miles)	4,282	57	4,145	4,349
Average Speed (mph)	18.5	0.7	18.0	20.0
Total Travel Time (hours)	234.8	11.5	216.6	257.1
Vehicles Entered	4,553	66	4,449	4,658
Vehicles Exited	4,478	51	4,372	4,539
Percent Demand Served	98.4%	0.9%	97.0%	99.7%
Fuel Used (gallons)	136	3	132	141
HC Emissions (grams)	1,554	107	1,438	1,765
CO Emissions (grams)	42,524	1,893	40,096	45,796
NOx Emissions (grams)	5,691	292	5,362	6,206

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 w peds**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	62	88.2%	370.1	122.7	F
	Through	1,609	1,537	95.5%	33.7	29.3	C
	Right Turn	283	283	99.8%	16.6	23.1	B
	Subtotal	1,962	1,882	95.9%	41.9	30.4	D
SB	Left Turn	117	118	100.5%	197.6	43.0	F
	Through	2,254	2,130	94.5%	123.6	22.9	F
	Right Turn	45	45	99.7%	107.5	23.5	F
	Subtotal	2,416	2,293	94.9%	127.0	22.0	F
EB	Left Turn	90	85	94.1%	55.8	8.0	E
	Through	71	79	110.9%	62.0	11.0	E
	Right Turn	250	251	100.3%	44.7	13.8	D
	Subtotal	411	414	100.8%	50.1	9.0	D
WB	Left Turn	154	160	103.7%	107.1	41.5	F
	Through	12	10	85.4%	115.9	42.4	F
	Right Turn	56	57	101.3%	52.6	45.5	D
	Subtotal	222	227	102.1%	93.7	44.4	F
Total		5,011	4,815	96.1%	86.0	10.6	F

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 no peds**
Network Performance **PM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	38.8	1.5	36.8	40.8
Total Delay (hours)	57	3	53	61
Average Stopped Delay (seconds)	13.1	1.2	11.8	14.5
Total Stopped Delay (hours)	19	2	17	21
Total Stops	2,003	114	1,849	2,192
Average Stops	0.38	0.02	0.35	0.40
Total Distance Traveled (miles)	6,526	87	6,336	6,648
Average Speed (mph)	28.5	0.5	28.0	29.0
Total Travel Time (hours)	230.3	4.9	221.3	238.6
Vehicles Entered	5,070	71	4,931	5,193
Vehicles Exited	5,078	73	4,916	5,171
Percent Demand Served	100.2%	0.4%	99.6%	100.8%
Fuel Used (gallons)	202	3	196	207
HC Emissions (grams)	1,964	96	1,819	2,094
CO Emissions (grams)	52,702	1,633	49,932	54,787
NOx Emissions (grams)	7,720	269	7,318	8,036

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 no peds**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	80	79	98.3%	96.2	39.6	F
	Through	2,244	2,214	98.7%	21.0	2.0	C
	Right Turn	61	59	97.4%	14.0	3.8	B
	Subtotal	2,385	2,352	98.6%	23.2	1.9	C
SB	Left Turn	25	23	91.2%	88.7	25.9	F
	Through	2,216	2,226	100.4%	34.6	8.4	C
	Right Turn	117	114	97.5%	18.8	8.0	B
	Subtotal	2,358	2,363	100.2%	34.5	8.2	C
EB	Left Turn	44	37	84.3%	64.4	12.6	E
	Through	15	15	100.7%	69.0	24.7	E
	Right Turn	190	186	97.7%	27.1	17.9	C
	Subtotal	249	238	95.5%	35.8	15.2	D
WB	Left Turn	80	83	104.0%	79.2	27.3	E
	Through	6	8	131.7%	84.2	47.5	F
	Right Turn	28	30	108.6%	1.2	0.2	A
	Subtotal	114	122	106.6%	60.6	22.1	E
Total		5,106	5,074	99.4%	30.1	3.8	C

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 w peds**
Network Performance **PM Peak Hour**

Performance Measure	Average	Std. Dev.	Minimum	Maximum
Average Delay (seconds)	68.3	6.1	59.9	77.7
Total Delay (hours)	101	9	88	116
Average Stopped Delay (seconds)	29.3	3.6	23.9	34.2
Total Stopped Delay (hours)	43	6	35	51
Total Stops	3,628	343	3,144	4,201
Average Stops	0.68	0.06	0.59	0.78
Total Distance Traveled (miles)	6,525	58	6,447	6,616
Average Speed (mph)	24.0	0.9	23.0	25.0
Total Travel Time (hours)	274.6	10.4	261.1	290.7
Vehicles Entered	5,083	66	5,003	5,206
Vehicles Exited	5,069	49	4,998	5,149
Percent Demand Served	99.7%	1.2%	97.2%	101.2%
Fuel Used (gallons)	213	3	208	218
HC Emissions (grams)	2,005	161	1,831	2,344
CO Emissions (grams)	52,803	2,503	50,382	58,394
NOx Emissions (grams)	7,771	415	7,354	8,689

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 w peds**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	80	75	93.8%	204.0	52.8	F
	Through	2,244	2,245	100.0%	38.6	7.0	D
	Right Turn	61	66	107.4%	27.4	6.3	C
	Subtotal	2,385	2,386	100.0%	43.8	5.6	D
SB	Left Turn	25	25	100.8%	112.2	30.2	F
	Through	2,216	2,184	98.6%	75.6	19.3	E
	Right Turn	117	116	98.8%	50.6	20.7	D
	Subtotal	2,358	2,325	98.6%	74.7	19.2	E
EB	Left Turn	44	44	100.5%	67.6	12.8	E
	Through	15	16	108.0%	48.4	17.6	D
	Right Turn	190	181	95.4%	22.3	9.9	C
	Subtotal	249	242	97.0%	32.5	8.3	C
WB	Left Turn	80	77	96.4%	112.9	48.6	F
	Through	6	7	118.3%	75.6	56.7	E
	Right Turn	28	28	101.1%	1.3	0.5	A
	Subtotal	114	113	98.7%	87.7	40.8	F
Total		5,106	5,065	99.2%	58.5	8.2	E

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Volume and Delay by Movement **2021 + Project - AM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	60	60	99.3%	7.8	2.1	A
	Through	1,369	1,360	99.4%	8.1	2.0	A
	Right Turn	137	139	101.8%	8.8	3.1	A
	Subtotal	1,566	1,559	99.6%	8.2	2.1	A
SB	Left Turn	56	57	101.6%	13.2	2.3	B
	Through	1,934	1,923	99.4%	14.6	3.3	B
	Right Turn	45	46	101.3%	15.3	5.3	C
	Subtotal	2,035	2,026	99.5%	14.6	3.3	B
EB	Left Turn	70	50	70.9%	565.3	162.8	F
	Through	35	27	77.7%	590.8	141.0	F
	Right Turn	220	163	74.0%	85.2	31.6	F
	Subtotal	325	240	73.7%	270.2	81.1	F
WB	Left Turn	75	75	100.3%	29.8	8.2	D
	Through	6	6	101.7%	36.8	22.3	E
	Right Turn	27	27	98.5%	0.0	0.0	A
	Subtotal	108	108	99.9%	24.0	7.1	C
Total		4,034	3,932	97.5%	25.8	3.2	D

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Volume and Delay by Movement **2021 + Project - PM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	72	103.3%	12.9	5.3	B
	Through	1,934	1,918	99.2%	13.1	5.9	B
	Right Turn	30	32	107.3%	13.4	6.3	B
	Subtotal	2,034	2,023	99.4%	13.1	5.8	B
SB	Left Turn	12	12	96.7%	14.3	6.7	B
	Through	1,906	1,891	99.2%	12.7	4.1	B
	Right Turn	97	98	100.8%	14.7	5.5	B
	Subtotal	2,015	2,000	99.3%	12.8	4.1	B
EB	Left Turn	44	45	102.7%	61.7	23.7	F
	Through	7	8	114.3%	53.0	29.3	F
	Right Turn	160	155	96.9%	0.5	0.3	A
	Subtotal	211	208	98.7%	18.2	9.8	C
WB	Left Turn	39	36	92.1%	113.1	48.5	F
	Through	3	3	96.7%	66.7	104.3	F
	Right Turn	13	13	101.5%	0.1	0.1	A
	Subtotal	55	52	94.5%	87.7	42.2	F
Total		4,315	4,283	99.3%	14.2	3.6	B

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Volume and Delay by Movement **2031 + Project - AM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	80	74	92.6%	72.8	5.7	F
	Through	2,244	2,001	89.2%	73.0	5.0	F
	Right Turn	61	55	90.5%	74.2	8.5	F
	Subtotal	2,385	2,131	89.3%	73.0	4.9	F
SB	Left Turn	25	21	85.2%	59.1	8.6	F
	Through	2,216	2,017	91.0%	64.9	5.9	F
	Right Turn	117	106	90.4%	66.7	6.3	F
	Subtotal	2,358	2,144	90.9%	64.9	5.9	F
EB	Left Turn	44	40	90.5%	465.5	259.1	F
	Through	15	14	94.0%	447.4	276.4	F
	Right Turn	190	178	93.5%	25.4	31.1	D
	Subtotal	249	232	93.0%	137.4	101.1	F
WB	Left Turn	80	49	61.6%	905.4	271.1	F
	Through	6	4	68.3%	608.2	477.8	F
	Right Turn	28	18	62.9%	191.8	171.7	F
	Subtotal	114	71	62.3%	839.0	286.9	F
Total		5,106	4,577	89.6%	83.3	10.0	F

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	70	99.3%	35.2	20.7	E
	Through	1,609	1,602	99.5%	36.7	21.7	E
	Right Turn	283	279	98.4%	38.6	22.0	E
	Subtotal	1,962	1,950	99.4%	36.9	21.7	E
SB	Left Turn	117	92	78.4%	81.8	5.7	F
	Through	2,254	1,777	78.8%	85.1	5.6	F
	Right Turn	45	37	81.3%	85.3	5.6	F
	Subtotal	2,416	1,905	78.9%	84.9	5.5	F
EB	Left Turn	90	30	33.7%	813.4	189.6	F
	Through	71	26	36.8%	848.7	173.4	F
	Right Turn	250	85	33.8%	142.0	77.2	F
	Subtotal	411	141	34.3%	415.5	148.0	F
WB	Left Turn	154	140	91.0%	201.8	76.2	F
	Through	12	11	94.2%	196.0	82.3	F
	Right Turn	56	54	96.3%	29.8	27.5	D
	Subtotal	222	205	92.5%	154.9	61.8	F
Total		5,011	4,201	83.8%	77.3	7.6	F

Attachment D – Detailed Queuing Results

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	1,397	101	12	174	24	202	31	0%	0%
	Through/Right	1,397	148	29	290	48	356	69	0%	0%
NB	Left Turn	540	79	18	145	38	166	47	0%	0%
	Right Turn	310	15	12	111	67	267	141	0%	0%
	Through	1,607	233	26	400	36	420	63	2%	0%
SB	Left Turn	1,350	93	24	238	66	352	71	0%	0%
	Right Turn	475	21	19	155	116	350	241	0%	0%
	Through	3,738	372	13	605	33	658	70	7%	0%
WB	Left Turn	1,548	104	20	181	34	197	39	0%	0%
	Through/Right	1,548	11	3	39	13	60	35	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	1,397	98	11	173	18	215	44	0%	0%
	Through/Right	1,397	141	14	267	33	305	60	0%	0%
NB	Left Turn	540	118	37	194	56	212	53	0%	0%
	Right Turn	310	44	26	212	94	301	106	0%	0%
	Through	1,607	298	20	428	42	494	80	4%	0%
SB	Left Turn	1,350	105	19	281	49	374	0	0%	0%
	Right Turn	475	29	21	195	116	400	211	0%	0%
	Through	3,738	462	28	695	53	815	97	12%	0%
WB	Left Turn	1,548	104	18	183	30	217	41	0%	0%
	Through/Right	1,548	10	4	33	7	40	11	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	2,211	63	11	119	22	143	29	0%	0%
	Through/Right	2,211	80	15	193	38	250	82	0%	0%
NB	Left Turn	540	88	19	162	43	207	59	0%	0%
	Right Turn	310	8	10	67	73	166	175	0%	0%
	Through	3,376	176	20	387	34	403	28	2%	0%
SB	Left Turn	1,350	19	9	62	48	92	101	0%	0%
	Right Turn	475	7	9	68	88	200	258	0%	0%
	Through	3,488	295	26	528	29	536	48	3%	0%
WB	Left Turn	2,436	53	13	102	25	125	35	0%	0%
	Through/Right	2,436	5	4	21	14	39	21	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	2,211	49	6	95	9	110	18	0%	0%
	Through/Right	2,211	85	13	195	28	280	78	0%	0%
NB	Left Turn	540	116	25	208	46	279	150	0%	0%
	Right Turn	310	18	17	121	82	265	139	0%	0%
	Through	3,376	344	32	533	48	582	64	9%	0%
SB	Left Turn	1,350	25	15	104	75	204	160	0%	0%
	Right Turn	475	52	32	289	97	500	0	0%	0%
	Through	3,488	417	28	603	34	690	103	10%	0%
WB	Left Turn	2,436	48	8	96	16	118	23	0%	0%
	Through/Right	2,436	6	4	24	10	37	9	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	1,397	166	13	264	33	299	41	0%	0%
	Through/Right	1,397	253	43	406	76	444	83	0%	0%
NB	Left Turn	540	141	51	255	76	347	160	0%	0%
	Right Turn	310	126	25	382	39	335	0	0%	0%
	Through	1,607	367	15	527	19	626	67	9%	0%
SB	Left Turn	1,350	187	22	369	35	374	0	0%	0%
	Right Turn	475	71	32	349	88	500	0	0%	0%
	Through	3,738	849	167	1,326	283	1,414	275	24%	0%
WB	Left Turn	1,548	161	68	250	97	271	100	0%	0%
	Shared	1,548	184	69	286	91	294	96	0%	0%

SimTraffic Post-Processor **Kihei High School**
Average Results from 10 Runs **2031 w peds**
Queue Length **AM Peak Hour**

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	1,397	145	13	230	20	252	36	0%	0%
	Through/Right	1,397	225	21	359	49	412	97	0%	0%
NB	Left Turn	540	269	112	436	157	453	140	9%	0%
	Right Turn	310	121	21	370	32	335	0	0%	0%
	Through	1,607	450	187	735	466	798	402	10%	3%
SB	Left Turn	1,350	226	33	413	40	374	1	3%	0%
	Right Turn	475	77	20	370	55	500	0	0%	0%
	Through	3,738	1,390	243	2,271	519	2,199	419	29%	0%
WB	Left Turn	1,548	126	25	203	54	208	47	0%	0%
	Shared	1,548	145	24	230	52	241	42	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	2,211	58	8	112	19	134	36	0%	0%
	Through/Right	2,211	117	21	230	47	273	63	0%	0%
NB	Left Turn	540	120	41	242	72	321	140	0%	0%
	Right Turn	310	25	20	155	78	301	106	0%	0%
	Through	3,376	295	32	548	48	537	83	6%	0%
SB	Left Turn	1,350	51	19	176	65	320	115	0%	0%
	Right Turn	475	62	44	315	120	500	0	0%	0%
	Through	3,488	478	54	750	88	806	140	12%	0%
WB	Left Turn	2,436	112	15	194	30	221	47	0%	0%
	Through/Right	2,436	12	5	38	9	52	11	0%	0%

Intersection 1 **Piilani Hwy/Kulanihakoi St** **Signal**

Direction	Lane Group	Storage (ft)	Average Queue (ft) Average	Average Queue (ft) Std. Dev.	95th Queue (ft) Average	95th Queue (ft) Std. Dev.	Maximum Queue (ft) Average	Maximum Queue (ft) Std. Dev.	Block Time Pocket	Block Time Upstream
EB	Left/Through	2,211	60	6	116	13	144	36	0%	0%
	Through/Right	2,211	122	10	234	22	274	42	0%	0%
NB	Left Turn	540	206	44	429	72	564	0	0%	0%
	Right Turn	310	61	30	263	79	335	0	0%	0%
	Through	3,376	607	48	909	148	1,032	215	21%	0%
SB	Left Turn	1,350	57	15	200	59	347	85	0%	0%
	Right Turn	475	135	49	489	99	500	0	0%	0%
	Through	3,488	954	184	1,494	353	1,511	277	27%	0%
WB	Left Turn	2,436	126	43	219	80	236	77	0%	0%
	Through/Right	2,436	11	6	35	9	45	15	0%	0%

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Queue Length **2021 + Project - AM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn	1,150	33	12	16	62	377	102	215	618	NO
	Through	1,150	33	12	16	62	377	102	215	618	NO
	Right Turn	1,150	33	12	16	62	377	102	215	618	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	1,050	99	31	51	161	655	132	524	930	NO
	Through	1,050	99	31	51	161	655	132	524	930	NO
	Right Turn	1,050	99	31	51	161	655	132	524	930	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	375	333	38	238	373	419	17	405	450	MAX
	Through	375	333	38	238	373	419	17	405	450	MAX
	Right Turn	350	0	0	0	0	0	0	0	0	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	310	11	3	7	16	109	22	86	158	NO
	Through	310	11	3	7	16	109	22	86	158	NO
	Right Turn	275	0	0	0	0	0	0	0	0	NO
	Second Right										

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Queue Length **2021 + Project - PM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn	1,150	87	26	49	127	772	219	433	1,114	NO
	Through	1,150	87	26	49	127	772	219	433	1,114	NO
	Right Turn	1,150	87	26	49	127	772	219	433	1,114	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	1,050	75	26	28	126	664	157	412	1,015	NO
	Through	1,050	75	26	28	126	664	157	412	1,015	NO
	Right Turn	1,050	75	26	28	126	664	157	412	1,015	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	375	19	7	10	29	139	33	82	181	NO
	Through	375	19	7	10	29	139	33	82	181	NO
	Right Turn	350	0	0	0	0	0	0	0	0	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	310	23	8	12	35	122	28	84	174	NO
	Through	310	23	8	12	35	122	28	84	174	NO
	Right Turn	275	0	0	0	0	0	0	0	0	NO
	Second Right										

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Queue Length **2031 + Project - AM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn	1,150	974	30	904	1,010	1,228	16	1,200	1,252	MAX
	Through	1,150	974	30	904	1,010	1,228	16	1,200	1,252	MAX
	Right Turn	1,150	974	30	904	1,010	1,228	16	1,200	1,252	MAX
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	1,050	844	46	763	902	1,122	11	1,106	1,140	MAX
	Through	1,050	844	46	763	902	1,122	11	1,106	1,140	MAX
	Right Turn	1,050	844	46	763	902	1,122	11	1,106	1,140	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	375	164	111	64	327	334	112	192	462	NO
	Through	375	164	111	64	327	334	112	192	462	NO
	Right Turn	350	0	0	0	0	0	0	0	0	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	310	294	37	205	320	360	19	340	397	MAX
	Through	310	294	37	205	320	360	19	340	397	MAX
	Right Turn	275	0	0	0	0	0	0	0	0	NO
	Second Right										

Vissim Post-Processor **Kihei HS Intersection Evaluation**
Average Results from 10 Runs **Roundabout**
Queue Length **2031 + Project - PM**

Intersection 1 **Piilani Highway/Kulanihakoi Street** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn	1,150	330	200	145	675	1,043	138	845	1,197	NO
	Through	1,150	330	200	145	675	1,043	138	845	1,197	NO
	Right Turn	1,150	330	200	145	675	1,043	138	845	1,197	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	1,050	934	18	906	953	1,130	14	1,106	1,147	MAX
	Through	1,050	934	18	906	953	1,130	14	1,106	1,147	MAX
	Right Turn	1,050	934	18	906	953	1,130	14	1,106	1,147	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	375	377	4	369	382	426	20	405	462	AVG
	Through	375	377	4	369	382	426	20	405	462	AVG
	Right Turn	350	0	0	0	0	0	0	0	0	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	310	230	52	174	302	361	19	341	397	MAX
	Through	310	230	52	174	302	361	19	341	397	MAX
	Right Turn	275	0	0	0	0	0	0	0	0	NO
	Second Right										

DAVID Y. IGE
GOVERNOR

JADE T. BUTAY
DIRECTOR

Deputy Director
LYNN A.S. ARAKI-REGAN
DEREK J. CHOW
ROSS M. HIGASHI
EDWIN H. SNIFFEN

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-P 2.3739

August 5, 2020

TO: RANDALL TANAKA
ASSISTANT SUPERINTENDENT
OFFICE OF FACILITIES AND OPERATION
DEPARTMENT OF EDUCATION

FROM: EDWIN H. SNIFFEN
DEPUTY DIRECTOR, HIGHWAYS DIVISION

SUBJECT: LAND USE COMMISSION MOTION
KIHEI HIGH SCHOOL, NEW SCHOOL

For the upcoming Land Use Commission meeting on the Kihei High School motion to amend in August of this year, the Hawaii Department of Transportation (HDOT) provides the attached justification. The attachment has been developed by HDOT Highways Division licensed engineers, Ken Tatsuguchi the Engineering Program Manager for the Planning Branch, Bryan Kimura the Engineering Program Manager for the Traffic Branch and Robin Shishido the Maui District Engineer.

If you have any questions, please contact me at (808) 587-2156 or by email at edwin.h.sniffen@hawaii.gov.

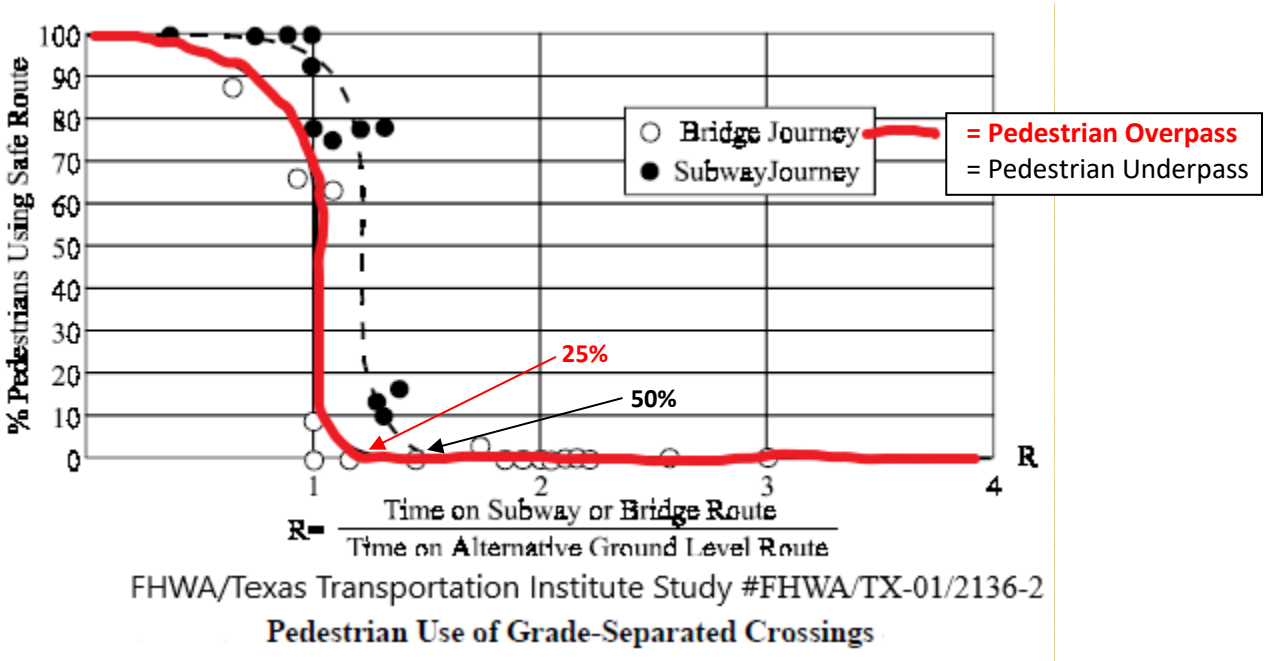
Attachment

EXHIBIT 12

7-15-20

Justification for a Roundabout on Piilani Highway for Kihei High School

1. Hawaii Department of Transportation (HDOT) does not recommend building an overpass because HDOT has concluded that no one is likely to use the overpass. HDOT determination is based on a FHWA sponsored study (FHWA/TX-01/2136-2) conducted by the Texas Transportation Institute, which found that virtually no one will use a pedestrian overpass if it takes 25% longer to cross compared to crossing at grade. See the graph below. Using an overpass at this location will take 130% longer with stairs and 510% longer with ramps. Pedestrians prefer to limit walking distance and will often take usual short cuts to save even a few steps and seconds of time. Because it will take significantly longer to cross using the overpass compared to at-grade, pedestrians avoiding the overpass will attempt to dangerously cross the traffic--a condition that should be avoided.
2. HDOT does not recommend building an underpass. In particular, use of Kulanihakoi Gulch for an underpass presents security issues as well as concerns for pedestrian safety in the event of a storm.



FHWA/Texas Transportation Institute Study #FHWA/TX-01/2136-2

Pedestrian Use of Grade-Separated Crossings

3. HDOT recommends a roundabout be developed instead. The roundabout at-grade pedestrian crossing is about a 130 feet distance, and the grade-separated overpass pedestrian crossing is about a 235 feet distance and a 760 feet distance for the stairway and ramp crossings, respectively.

Between a signalized intersection and roundabout, HDOT recommends a roundabout because it is substantially safer than a signalized intersection. According to the American Association of State Highway Transportation Officials (AASHTO) Highway Safety Manual roundabouts reduce the types of crashes where people are seriously hurt or killed

Kihei High School
Pedestrian Underpass Analysis Process

To determine the feasibility and safety of using an existing gulch crossing for a pedestrian underpass the following steps are required:

1. An elevated pedestrian crossing is used. The vertical clearance required for a bicycle and pedestrian use is 8 to 10 feet.

2. Ideally, the minimum elevation of the crossing should be higher than the "water surface elevation" for a 100-year storm. Lesser recurrence intervals may be utilized based on engineering judgement.

3. To determine the "water surface elevation" a Hydrologic Study (identifies the volume or amount of water, Q=CIA, regression equation, stream gauge analysis, etc.) and a Hydraulic Study (identifies the depth of flow, flow velocity, and forces from flowing water, HEC RAS or similar Program) must be completed.

4. Adding non-permeable material such as a raised sidewalk in a channel will decrease the waterway opening for the water flow to pass through. The existing waterway opening must have sufficient area to pass the design flow. Additionally, further analysis is required upstream and downstream to determine possible negative hydraulic impacts, such as flooding caused by the decreased the waterway opening.

5. Kulanihakoi Gulch as-built (1978) provides a 7' clearance between the stream bed and bridge soffit. This vertical clearance is not sufficient for bicycle and pedestrian clearance of 8 to 10 feet and to pass a 100-year storm.

   From the FEMA map there was an analysis makai of the Kulanihakoi Gulch bridge. It shows the 100-year flood is wider than the bridge. Therefore, the proposed pedestrian underpass will be built in the 100-year flood area or footprint.

6. Waipuilani Gulch as-built (1978) provides 11' clearance between the stream bed and bridge soffit. This vertical clearance is not sufficient bicycle and pedestrian clearance of 8 to 10 feet and to pass a 100-year storm.

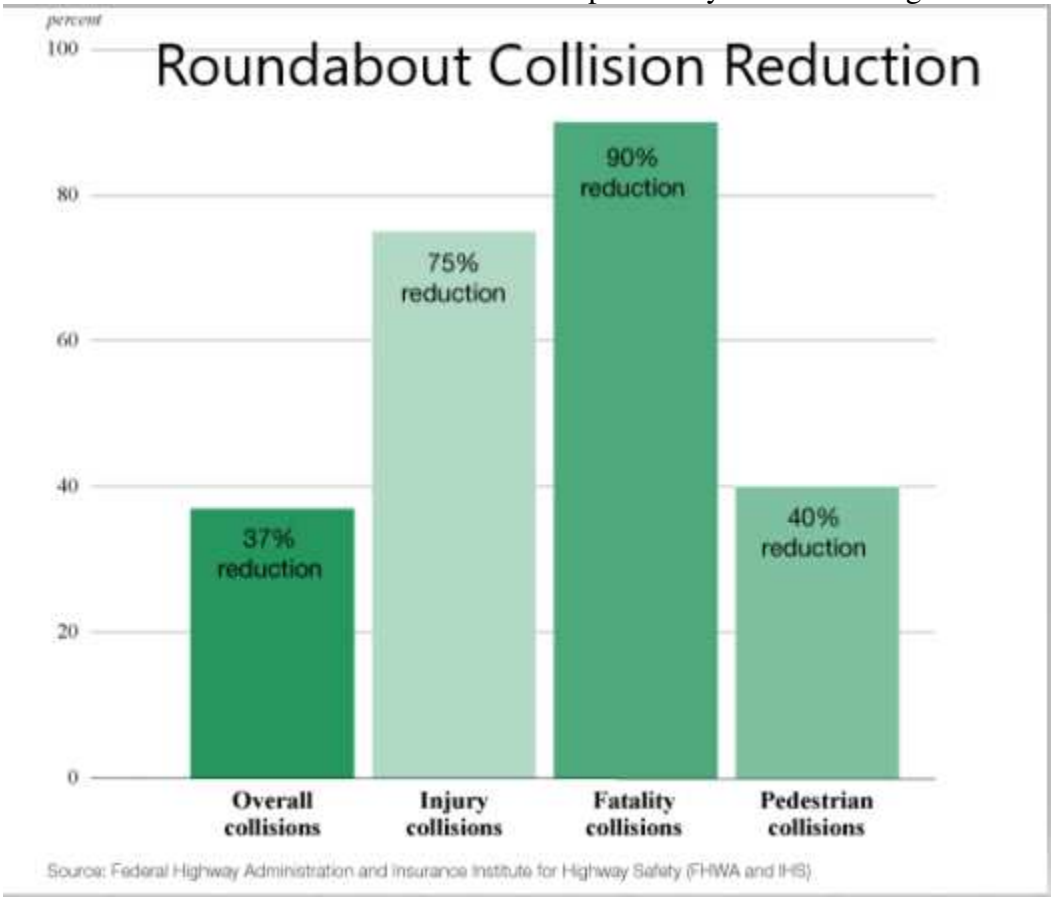
   The FEMA map shows no analysis for Waipuilani Gulch. However, it is likely similar to Kulanihakoi Gulch since the gulches are in close proximity that serve the same watershed.

7. The pedestrian underpass facility will add a distance of 500 feet for pedestrians, therefore the distance to cross Piilani Highway from the high school to Kulanihakoi Street will be about 2,500 feet at Kulanihakoi Gulch and 2,900 feet at Waipuilani Gulch.

8. HDOT has not conducted an analysis, but from available information it was found that using Kulanihakoi Gulch or Waipuilani Gulch for a pedestrian underpass will not be feasible, is unsafe, and not be used.

EXHIBIT 13

by 78-82% when compared to conventional stop-controlled and signalized intersections. Federal Highway Administration and Insurance Institute for Highway Safety studies show that properly designed roundabouts result in a 37% reduction in overall collisions, a 40% reduction in pedestrian collisions, and a 90% reduction in fatalities over more traditional signalized and stop-controlled intersections. See the chart below. In addition to lowering vehicle speeds, roundabouts make intersections safer for pedestrians of all ages by minimizing conflicts, eliminating crashes caused by drivers disregarding traffic signals and stop signs, and minimizing pedestrian exposure to traffic by enabling people to cross narrow travel lanes that are separated by a median refuge at each approach.



4. HDOT does not recommend the use of Kulanihakoa Gulch Bridge or Waipulani Gulch Bridge as an underpass since the purpose of the gulch is to pass hydraulic flows, and not as a pedestrian crossing. In the case of heavy rains, the gulches will be passing water which will cause for a hazardous and unsafe condition for pedestrians using either of these bridges as an underpass crossing. Furthermore, if the travel time using the underpass crossing takes 50% longer than the time to cross at-grade, no pedestrians will use the underpass. Kualanihakoi Gulch Bridge and Waipuilani Gulch Bridge are 1,000 feet and 1,200 feet from the proposed Kihei High School entrance, respectively. The at-grade pedestrian roundabout crossing is about 130 feet.

5. HDOT is presently taking action to improve traffic safety on Piilani Highway. At the Piilani Highway/Uwapo Road and Piilani Highway/Ohukai Road intersections, HDOT is

adjusting the signal timing coordination to slow down traffic. At Piilani Highway/Moi Place, the only uncontrolled crosswalk on Piilani Highway, HDOT is adding signing, striping, and lighting improvements to improve pedestrian safety. The proposed roundabout will provide additional traffic slowing and calming measures in the corridor to improve safety.

6. The roundabout and the intersection will operate about the same vehicular levels during the AM and PM peak hours. However, during non-peak hours the roundabout is expected to work less efficiently by adding minimal travel time due to slowing down to go through the roundabout versus going through the green phase of a traffic signal. However, HDOT believes the benefit trade-off towards pedestrian safety than vehicular travel time is a higher priority.

7. Building a school on the mauka side, which was previously unoccupied, changes the traffic conditions by adding vehicle turning trips and pedestrian crossings that did not occur previously. The proposed roundabout and pedestrian crossing safety measures will substantially minimize the traffic impacts of this land use change.

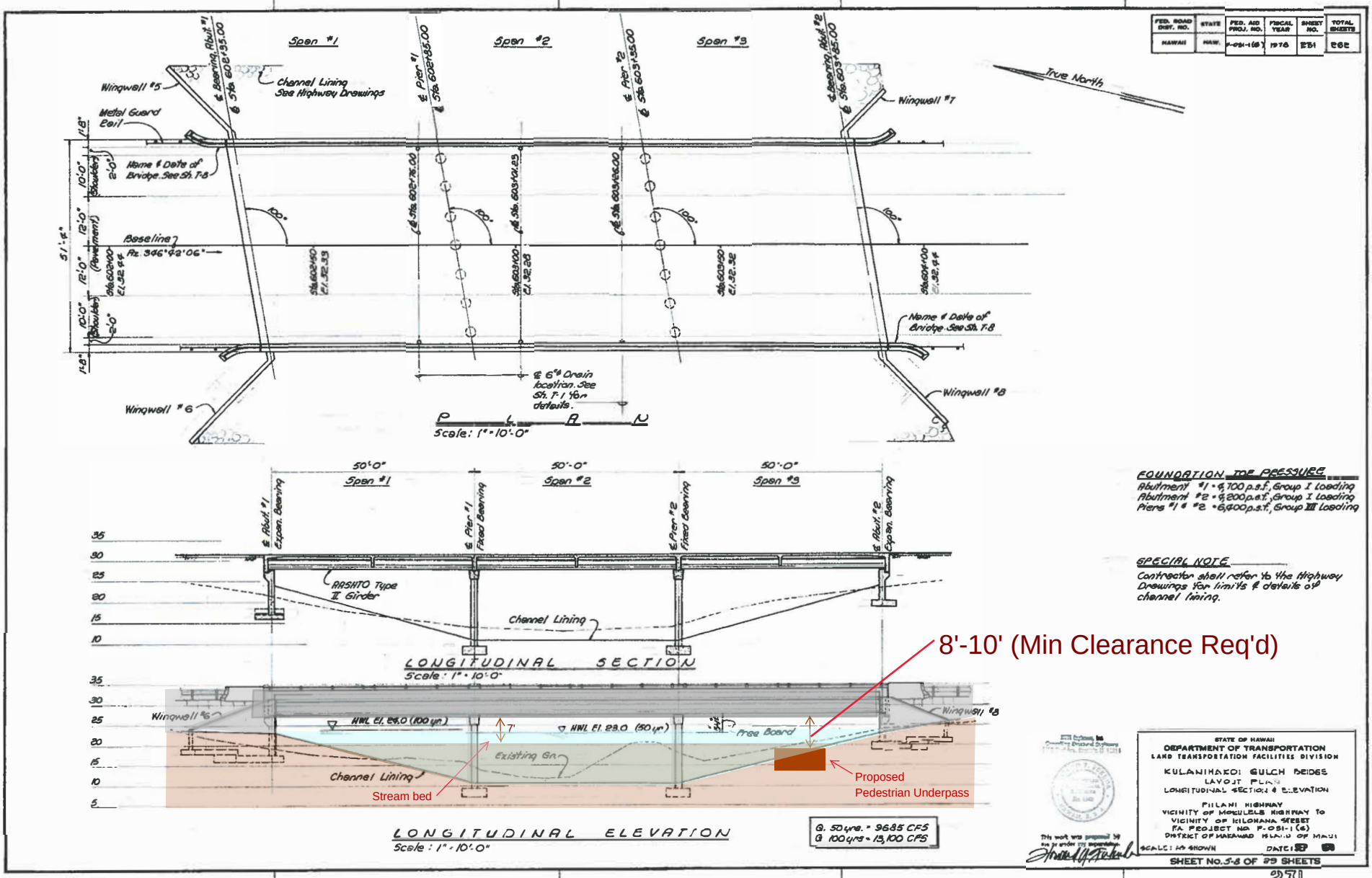

Span #1
Span #2
Span #3
Wingwall #5
Channel Lining
See Highway Drawings
Metal Guard Rail
Name & Date of Bridge. See Sh. T-8
Baseline
Pt. 346°42'06"
Wingwall #6
Wingwall #7
Wingwall #8
True North
& 6"ø Drain location. See Sh. T-1 for details.
PLAN
Scale: 1"=10'-0"
50'-0"
Span #1
Span #2
Span #3
℄ Abut. #1 Expan. Bearing
℄ Pier #1 Fixed Bearing
℄ Pier #2 Fixed Bearing
℄ Abut. #2 Expan. Bearing
AASHTO Type II Girder
Channel Lining
LONGITUDINAL SECTION
Scale: 1"=10'-0"
HWL El. 24.0 (100 yr.)
HWL El. 23.0 (50 yr.)
7'
Free Board
Existing Gr.
Channel Lining
Stream bed
Proposed Pedestrian Underpass
8'-10' (Min Clearance Req'd)
LONGITUDINAL ELEVATION
Scale: 1"=10'-0"
Q 50 yrs. = 9685 CFS
Q 100 yrs = 13,100 CFS
FOUNDATION TOE PRESSURE
Abutment #1 = 6,700 p.s.f., Group I Loading
Abutment #2 = 6,200 p.s.f., Group I Loading
Piers #1 & #2 = 6,900 p.s.f., Group III Loading
SPECIAL NOTE
Contractor shall refer to the Highway Drawings for limits & details of channel lining.
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
LAND TRANSPORTATION FACILITIES DIVISION
KULANIHAKOI GULCH BRIDGE
LAYOUT PLAN
LONGITUDINAL SECTION & ELEVATION
PILANI HIGHWAY
VICINITY OF MOKULELE HIGHWAY TO VICINITY OF KILOHANA STREET
FA PROJECT NO. F-031-1(6)
DISTRICT OF MAKAWAO ISLAND OF MAUI
SCALE: AS SHOWN
SHEET NO. 5-8 OF 29 SHEETS
231

EXHIBIT 14

FEMA Flood Map
Kulanihakoi Gulch

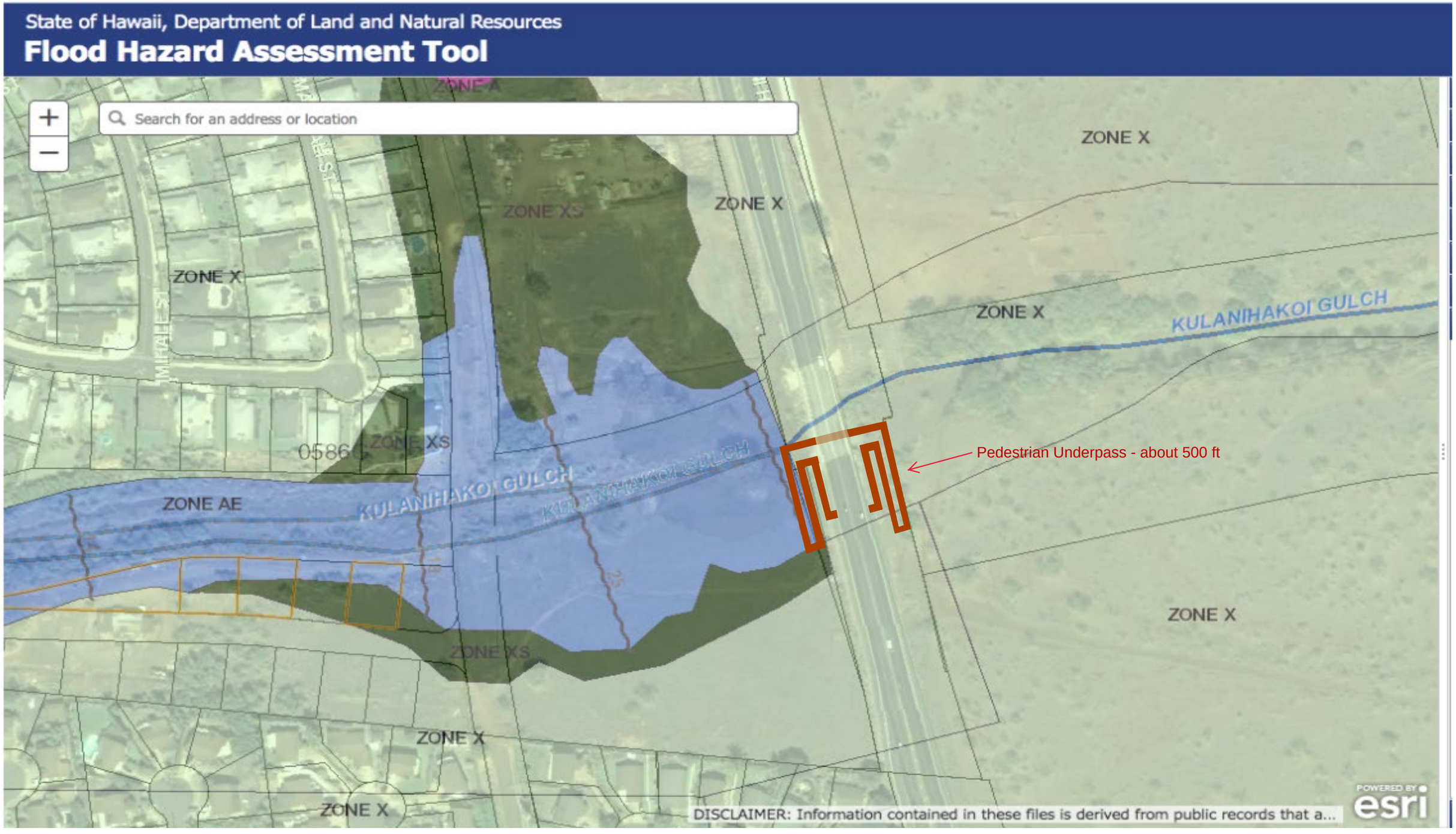
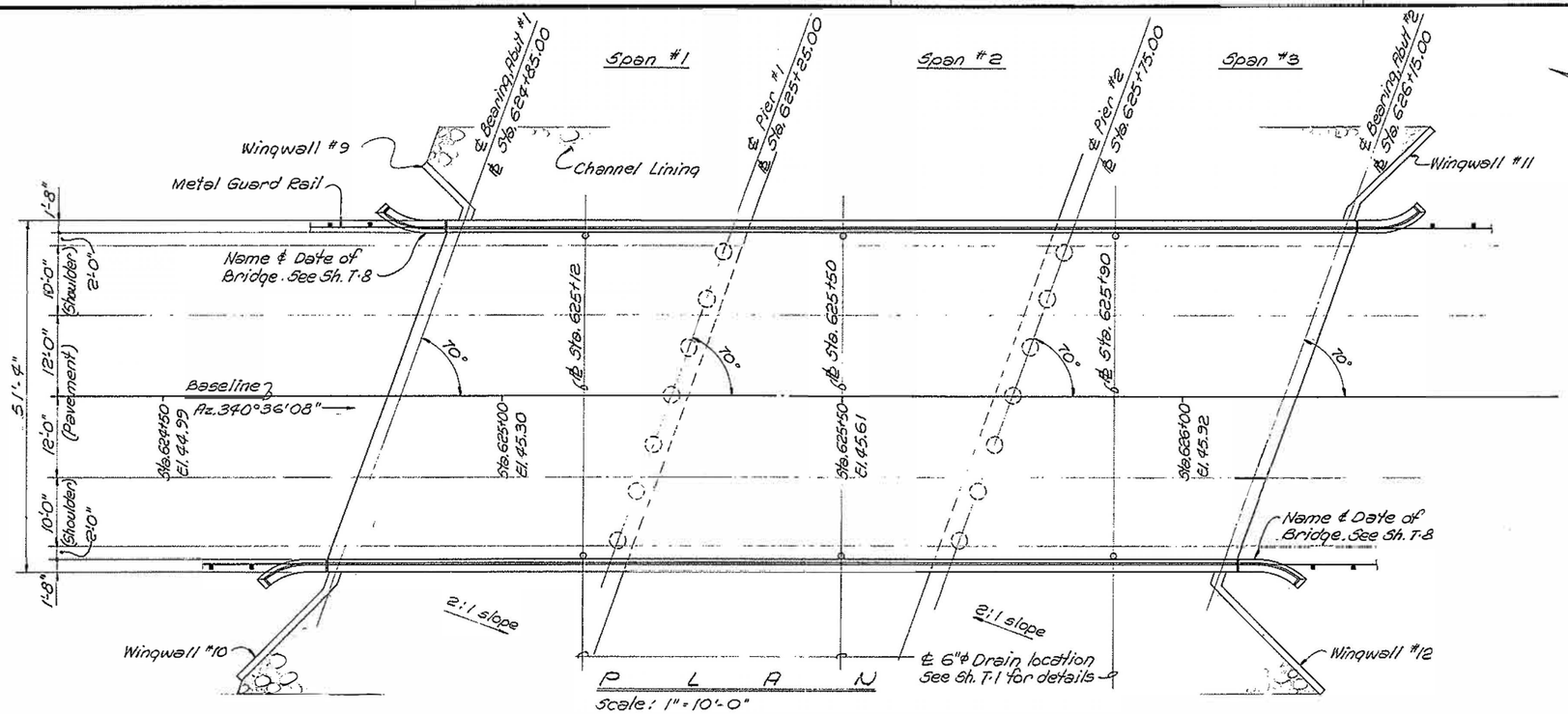
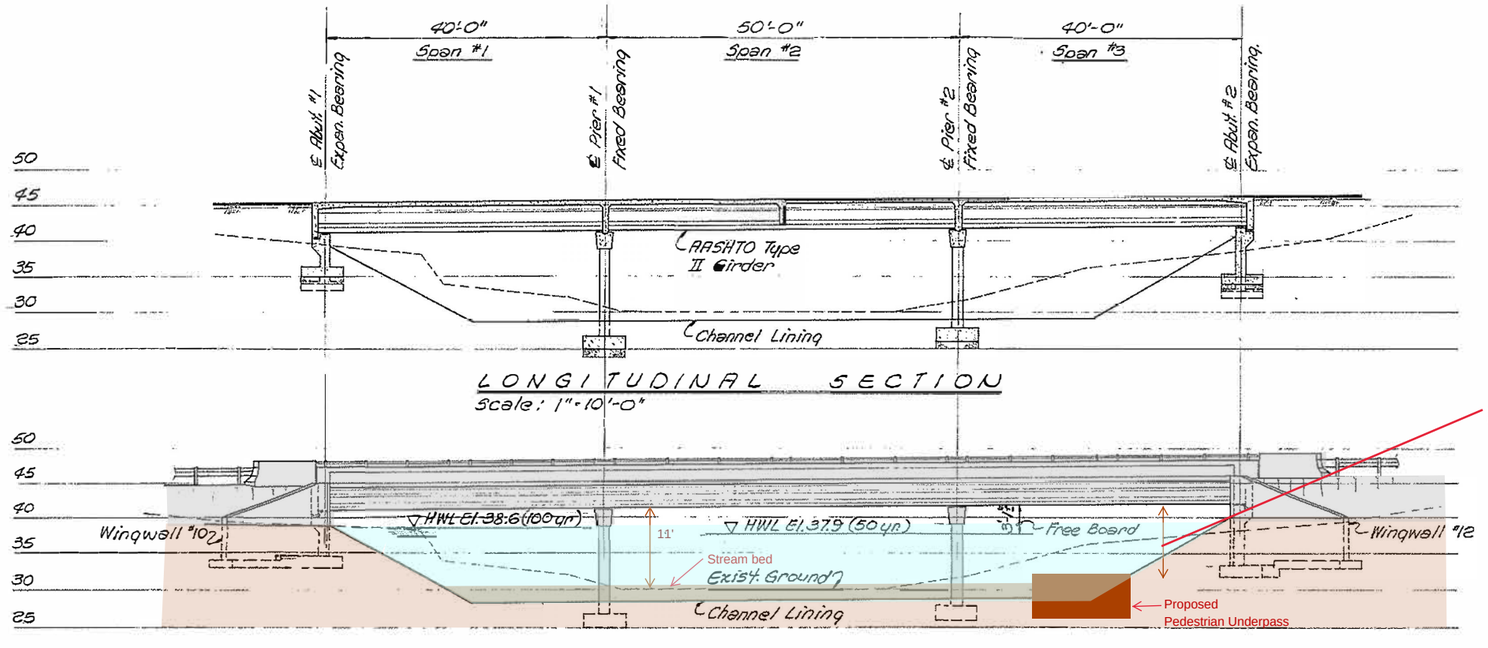


EXHIBIT 15

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	F-031-1(6)	1978	237	262





Q 50 yrs = 7880 CFS
Q 100 yrs = 9995 CFS

FOUNDATION TOE PRESSURE

Abutments - 4,000 p.s.f., Group I Loading
Piers - 3,000 p.s.f., Group I Loading

SPECIAL NOTE

Contractor shall refer to the Highway Drawings for limits & details of channel lining.

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	
	TRACED BY	
	DESIGNED BY	
NOTE BOOK	QUANTITIES BY	
No	CHECKED BY	

SSFH Engineers, Inc.
Consulting Structural Engineers
Honolulu, Hawaii 96814

REGISTERED PROFESSIONAL ENGINEER No. 1313 HAWAII

This work was prepared by me or under my supervision
Howard W. Richards

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
LAND TRANSPORTATION FACILITIES DIVISION

WAIPUILANI GULCH BRIDGE
LAYOUT PLAN
LONGITUDINAL SECTION & ELEVATION

PIILANI HIGHWAY
VICINITY OF MOKULELE HIGHWAY TO VICINITY OF KILOHANA STREET
F.A. PROJECT NO. F-031-1(6)
DISTRICT OF MAKAWAO ISLAND OF MAUI

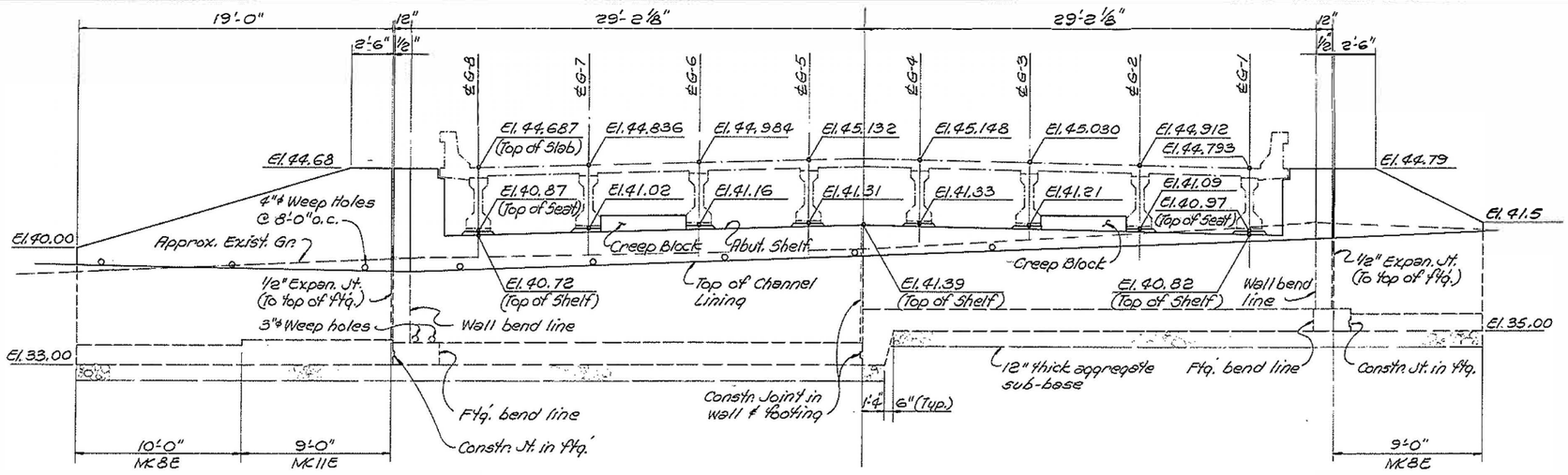
SCALE: AS SHOWN DATE: SEP 1978

SHEET NO. 5-14 OF 25 SHEETS

237

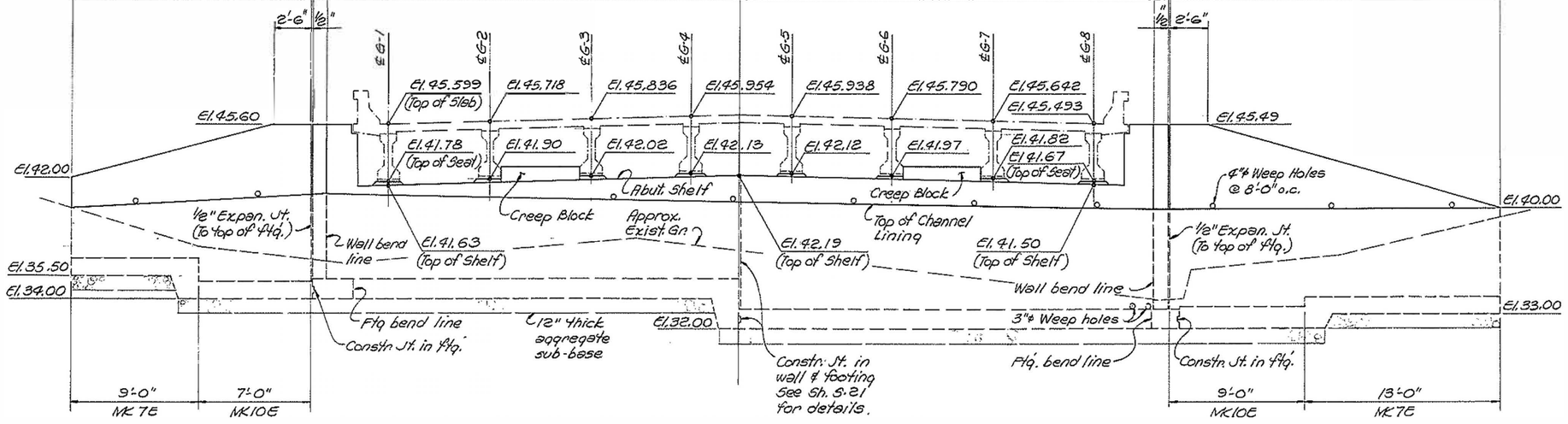
EXHIBIT 16

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	F-031-1(6)	1978	241	262



WINGWALL #10 — ABUTMENT #1 — WINGWALL #9

℄ Abut. # Baseline



WINGWALL #11 — ABUTMENT #2 — WINGWALL #12

NOTE

Horizontal wingwall dimensions shown are as rotated to plane of abutment. See Plan.

WAIPUILANI BRIDGE WALL ELEVATIONS

Scale: 1/4" = 1'-0"

REFERENCE DRAWINGS

1. Abutment details — Sh. S.20 & S.21
2. Wingwall details — Sh. T.9 & T.10

ORIGINAL PLAN	SURVEY PLOTTED BY	DRAWN BY	TRACED BY	DESIGNED BY	QUANTITIES BY	CHECKED BY	DATE
NOTE BOOK							
No.							

SSFM Engineers, Inc.
Consulting Structural Engineers
1210 Third Ave., Honolulu HI 96816

HOWARD Y. FUKUDA
REGISTERED PROFESSIONAL ENGINEER
No. 1343
HAWAII, U.S.A.

This work was prepared by me or under my supervision.

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
LAND TRANSPORTATION FACILITIES DIVISION

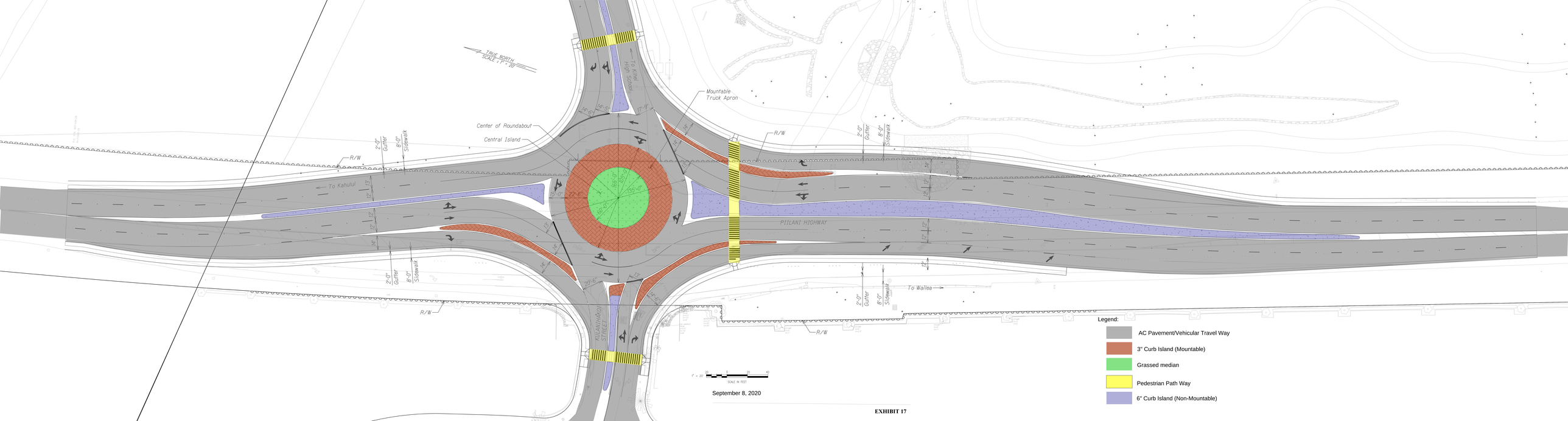
WAIPUILANI GULCH BRIDGE

ABUTMENT & WINGWALL ELEVATIONS

PIILANI HIGHWAY
VICINITY OF MOKULELE HIGHWAY TO
VICINITY OF KILOHANA STREET
FA. PROJECT NO. F-031-1(6)
DISTRICT OF MAKAWAO ISLAND OF MAUI

SCALE: AS SHOWN DATE SEP 1978

SHEET NO. S-18 OF 29 SHEETS

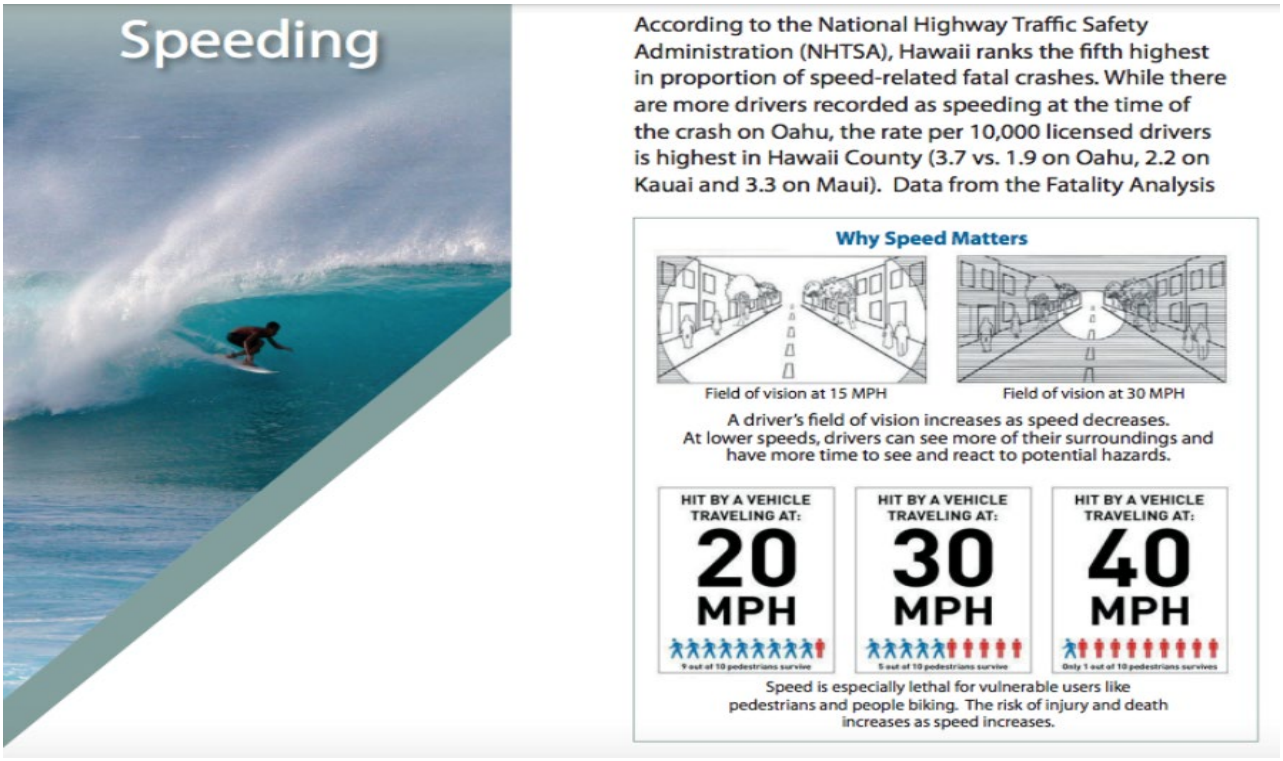

TRUE NORTH
SCALE: 1" = 40'
To Kihei High School
Mountable Truck Apron
Center of Roundabout
Central Island
R/W
2'-0" Gutter
8'-0" Sidewalk
To Kahului
PI'ILANI HIGHWAY
To Wailea
KULANIHAKOI STREET
Legend:
AC Pavement/Vehicular Travel Way
3" Curb Island (Mountable)
Grassed median
Pedestrian Path Way
6" Curb Island (Non-Mountable)
SCALE IN FEET
September 8, 2020
EXHIBIT 17

From the **HDOT Strategic Highway Safety Plan**

Getting struck at 20 mph by a vehicle, 9 out of 10 pedestrians survive or 1 death.

Getting struck at 30 mph by a vehicle, 5 out of 10 pedestrians survive or 5 deaths.

Getting struck at 40 mph by a vehicle, 1 out of 10 pedestrians survive or 9 deaths.



From the **Institute of Transportation Engineers (ITE)**
Note: Percentages are the same but ITE uses "death and severe injury" vs HDOT uses "death".

EXHIBIT 18

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI'I

In the Matter of the Petition of DEPARTMENT OF EDUCATION, STATE OF HAWAI'I, To Amend the Agricultural Land Use District Boundaries into the Urban Land Use District for Approximately 77.2 acres of land at Kihei, Maui, Hawai'i, Maui Tax Map Key Nos. 2-2-02: 81 and 83.	DOCKET NO. A11-794 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY THAT a copy of PETITIONER DEPARTMENT OF EDUCATION, STATE OF HAWAII'S UPDATE REGARDING ITS MOTION TO AMEND THE LAND USE COMMISSION'S FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER FILED JULY 29, 2013 was duly served via Electronic Mail upon the following at:

MOANA LUTEY (Moana.Lutey@co.maui.hi.us)
Corporation Counsel
THOMAS KOLBE (Thomas.Kolbe@co.maui.hi.us)
MICHAEL K. HOPPER (Michael.Hopper@co.maui.hi.us)
Deputies Corporation Counsel
County of Maui
200 South High Street
Kalana O Maui Building, 3rd Floor
Wailuku, Maui, Hawai'i 96793

Attorneys for Respondent
DEPARTMENT OF PLANNING,
COUNTY OF MAUI

DAWN TAKEUCHI APUNA (Dawn.T.Apuna@hawaii.gov)
Deputy Attorney General
425 Queen Street
Honolulu, Hawai‘i 96813

Attorney for Office of Planning

DATED: Honolulu, Hawai‘i, November 2, 2020.

/s/ Stuart N. Fujioka
STUART N. FUJIOKA
RYAN W. ROYLO
MELISSA J. KOLONIE
HOLLY T. SHIKADA
Deputy Attorneys General

Attorneys for Petitioner
DEPARTMENT OF EDUCATION,
STATE OF HAWAI‘I

Docket No. A11-794; In the Matter of the Petition of Department of Education, State of Hawai‘i, before the Land Use Commission of the State of Hawai‘i; PETITIONER DEPARTMENT OF EDUCATION, STATE OF HAWAII’S UPDATE REGARDING ITS MOTION TO AMEND THE LAND USE COMMISSION’S FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER FILED JULY 29, 2013; EXHIBITS 10-18; CERTIFICATE OF SERVICE