PFES 2.0

PLAN FOR EVERY SECTION

USER GUIDE

Updated 07.13.2020

MANDLI COMMUNICATIONS

AT A GLANCE

The plan is structured around recommended programs (major, minor rehabilitation, preservation) and projects to be completed over a 3-year period.

WHAT CAN PFES DO?

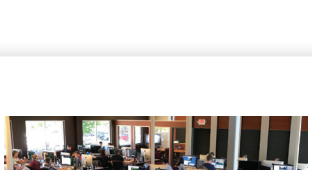
GIVE planners a tool to manage roads by dividing the routes into individual sections, with each section having its own trackable history.

ALLOW a highway department to systematically review all sections and strategically plan for their maintenance. Each section has a specific recommended program based on the existing pavement distresses, proposed treatments, quantifiable benefits and costs.

DEVELOP a "three-year plan" to help department staff prioritize different sections that can be reported for the entire agency, a specific district, treatment, or condition.

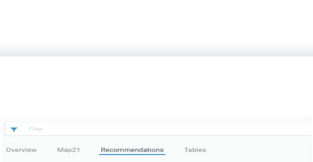
PROVIDE critical coordination among department staff, identifying specific preservation treatments and costs per year.

ASSIST with developing a communication tool for the public, contractors, and government officials.



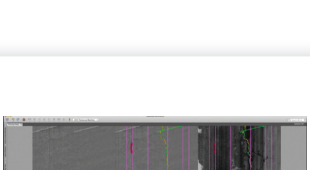
COLLABORATION

- PFES provides a space where data can be linked together for collaboration efforts and data transparency throughout the agency.
- PFES combines pavement data, surface area calculations, traffic data, and construction costing information, allowing the data to be shared between groups or even within a single group.



ACCESSIBILITY

- PFES provides an accessible view of data while allowing users to drill down for details since roadway condition tables can have close to 80 fields and tens of thousands of rows per collection year.
- PFES summarizes data into a number of straightforward graphical representations of road condition, traffic volume, treatment recommendations, and estimated costs to provide answers to fundamental questions anticipated by an agency.



VALIDATION

- PFES aids the customer in validating their funding requests.
- PFES quantifies the area in need of repair, the cost for selected treatment, and the benefits of recommended preservation, giving staff the ability to know where to allocate the first and last pavement preservation dollar and the expected performance.

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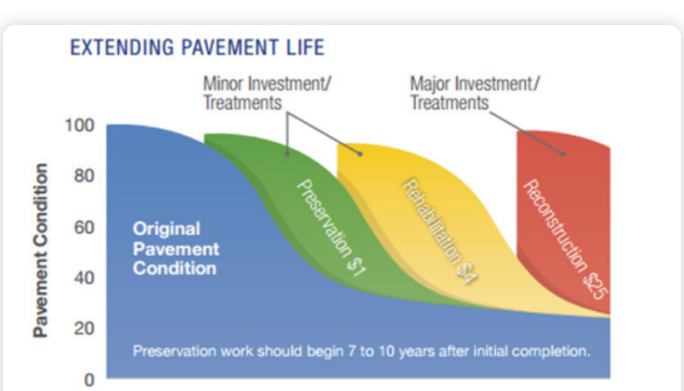
Hawaii Department of Transportation (HDOT) has implemented a pavement management program to preserve Hawaii's existing infrastructure. This program recommends scheduling timely regular maintenance and performing preservation treatments, in conjunction with rehabilitation and reconstruction to extend the life of the pavement. Scheduling regular upkeep will help prevent deterioration and provide the best value to the agency at the lowest life cycle cost.



1.1 | Good Roads Cost Less

The Department manages and preserves approximately 5,000 lane miles across the state from multi-lane urban concrete interstates to rural two-lane asphalt roads. The Department's pavement management philosophy is not a "worst-first" strategy, but selection of treatments that provides the greatest benefit at the lowest cost and can be summarized with the expression "Good Roads Cost Less." This is the philosophy of timely, cost-effective treatments that minimize cost while achieving the greatest long-term benefit.

Good Roads Cost Less

This is the philosophy of timely, cost-effective treatments that will minimize cost while achieving the greatest long-term benefit.

1.2 | A Plan for Every Section (PFES)

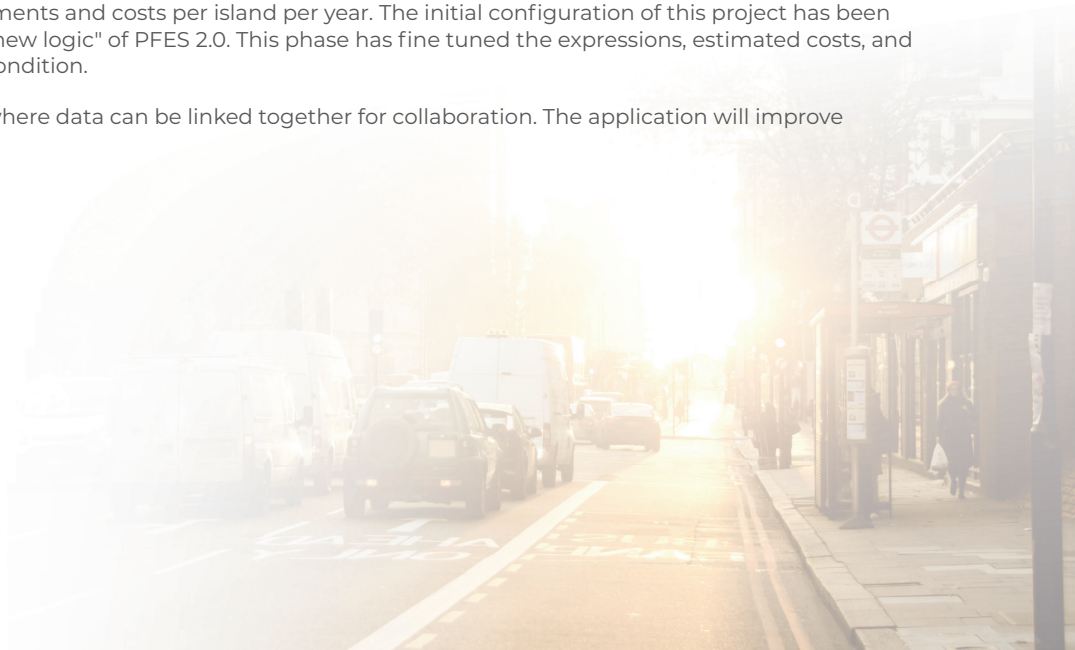
Mandli has worked with Hawaii DOT to create A Plan for Every Section of Every Road on Every Island (PFES). The "Plan" allows the department to systemically preserve the department's highways. This plan manages all the department's 92 state highways by dividing the state routes into approximately 1,000 logical, individual sections. Each individual section has its own history, including when it may have been originally constructed, how it has been maintained in the subsequent years, pavement surface distresses (ride, cracking, faulting, rutting, etc.), traffic volumes, type of facility (National Highway System, urban, rural), and when the next preservation is scheduled. A Benefit/Cost score is calculated for all recommended treatments. Each recommended project is ranked based on the benefit/cost ranking. This allows the agency to determine the most cost-effective projects for the department.

In addition to combining data, another objective of this project is to provide a more accessible view of the data while still being able to drill into the granule information. As an example, the users are able to not only determine the most cost effective projects for the entire department but also the cost effective project per island, or interstate, or for high AADT roads.

PFES allows the user to access all the meta data through roadway condition tables. There are approximately 80 fields and tens of thousands of rows per collection year. The graphical data is summarized into a number of straightforward graphical visual representations of road condition, traffic volume, treatment recommendations, and estimated costs to provide answers to fundamental questions anticipated by HDOT.

One of the final goals of PFES was to aid the DOT in validating their funding requests by being able to quantify the number of lanes miles in need of repair and a cost for those repairs. The plan also provides for critical coordination among the department staff identifying specific preservation treatments and costs per island per year. The initial configuration of this project has been completed. This manual incorporates the "new logic" of PFES 2.0. This phase has fine tuned the expressions, estimated costs, and thresholds that categorize the pavement condition.

PFES was designed to provide a platform where data can be linked together for collaboration. The application will improve transparency throughout the agency.



2.1 | HAWAII PFES SECTIONS

The driving force of Hawaii's Plan for Every Section is the PFES Section Data table. To generate the table, each district provided logical segments of their state roads. Segments, or PFES sections, were chosen based on similar pavement distresses within the section. Sections were also chosen on the district's intent to maintain a stretch of road or how a stretch of road was maintained in the past.

In general, these sections should not be too long to maintain but nor be so short to be cumbersome to track. The route name and mileage, rounded to the nearest 0.01 mile, created a unique ID for each section. This ID was also given to the two datasets mentioned below to join them together.

2.2 | MANDLI PAVEMENT CONDITION DATA

Each year Mandli collects both pavement and roadway condition data for HDOT. The initial PFES model has been constructed using 2016 and 2017 pavement condition submittals by Mandli. Today's model uses pavement distress data from the 2019 (winter, spring) inventory. Pavement condition data was originally reported at 0.1 mile intervals for both asphalt and concrete pavements. 2020 pavement distress data will be added as it becomes available.

Additional detail on the pavement condition reports can be found in the Mandli Data Dictionary. Information capturing roadway cracking, ride quality, rutting, and faulting were summarized into the HDOT provided PFES Sections mentioned in the section below.

2.3 | MANDLI SURFACE AREA DATA

In addition to the pavement condition reporting, Mandli also collected pavement surface area through linework in the LiDAR point cloud. Surface area data includes pavement in the traveled lanes, ramp, collectors, and roadway shoulders. Reports were generated and data combined for each PFES section and is reported in square yards.

2.4 | HAWAII DOT TRAFFIC VOLUME DATA

To aid in prioritizing roads in Hawaii the traffic volume of each section had to be estimated. Traffic count data submitted in 2018 was assigned to each PFES section using the Maximum AADT if multiple HPMS sections fell within a single PFES section. AADT was broken down into passenger vehicles, combination truck traffic, and single unit trucks.

3.1 | NORMALIZATION OF DISTRESS

1. Overview:
   a. In order to treat all roads equally the road condition characteristics had to be normalized into values between 0-100 where 100 is perfect condition. The data from the Mandli condition reports are listed below for each pavement type.
2. Asphalt normalization distresses
   a. Fatigue/Wheelpath Cracking: The area of load based cracking was compared against the total area of the road. Furthermore, the incorporation of potholes following an approximate interpretation of PCI deduction methodology for potholes.
   b. Environmental Cracking: Environmental cracking is composed of longitudinal cracking, block cracking, and transverse cracking. The sum of these types of cracking were then compared against the total lane surface area for a section.
   c. Ride: Normalized ride quality was determined by taking the average IRI for a PFES section and then using 40% of that value as a deduct from 118.
   d. Rutting: Rutting of both wheelpaths, given in inches, was averaged and then normalized.
3. Concrete normalization distresses
   a. Joint Spall: Number of transverse joints affected - low (<3" wide), medium (3"to 6" wide) and high >6" wide).
   b. Slab Cracked: Number of slabs cracked; Low Severity (not recorded), Medium Severity (broken into 3 pieces), High Severity (broken into 4 or more pieces).
   c. Faulting: a normalized fault value was derived from average joint faulting, given in inches, using both wheel paths and over each PFES section.
   d. Ride: Like asphalt, normalized ride quality was determined by taking the average IRI for a PFES section. However, higher IRI values were tolerated on concrete compared to asphalt roadways.

FIGURE 1 | INDEX FORMULAS

Ride	118 - .4(IRI)	
Rut	100 - (50/0.5)(Rut)	
Fat Crk	100 - ((50/633.6)(Med+High-Pothole deduct))	previous formula based on % of wheel path - current data is % of lane
Env Crk	100 - ((50/52.8)(Low T)+(50/39.6)(Med T)+(50/26.4)(High T)+(50/1584)(Low L)+(50/1188)(Med L)+(50/792)(High L)+(50/6336)(Low B)+(50/4752)(Med B)+(50/3168)(High B) OR 100 - (50/1584)(Patch)	
	combination of Transverse, Longitudinal & Block, or based on area of Patching - formula needs to be updated to include sealed cracks	
Ride	126 - .4(IRI)	PFES allows 20" of more IRI for concrete
Fault	100 - ((50/35)(Low)+(50/8.75)(Med)+(50/3.5)(High))	
Jt Spall	Min(100 - ((50/10.5)((Low (T+L)+Med (T+L)+High (T+L)), 100 - (50/12.25)(Patch))	
Slab Crk	100 - ((50/8.75)(Low+Med+High CrnBrk)+(50/8.75)(Low Divided Slab+Medium Divided Slab+High Divided Slab)+((50/10.5)((Low (T+L)+Med (T+L)+High (T+L)))	
	combination of cornerbreaks, shattered slabs & cracked slabs	
	Shattered Slab Measure: Count only if there are a minium one Long and Transverse crack per slab	

FIGURE 2 | REVIEW ASPHALT OCI

Distress	Existing	Proposal 1	Proposal 2	Proposal 3
Ride	0.25	0.3	0.2	0.1
Fat Cracking	0.25	0.3	0.45	0.45
Environmental	0.25	0.25	0.25	0.35
Rut	0.25	0.15	0.1	0.10

3.2 | ASPHALT OCI CALCULATIONS AND CONDITION

Overall Condition Index (Asphalt OCI) is the evenly weighted average of the roadway condition characteristics mentioned in the Normalization of Distress section. PFES sections are categorized into Good, Fair, and Poor condition using the OCI value of that section. The OCI is comprised of normalized asphalt distress values - ride, rut, fatigue and environmental cracking or for concrete – ride, joint spall, slab cracking, and faulting. PFES 1.0 displayed the road conditions by equally weighted pavement distresses. PFES 2.0 weights fatigue cracking (see 3.6 discussion below) OCI values of 80 or higher are considered Good, sections, less than 80 and greater than or equal to 60 are Fair, and all sections below an OCI of 60 are Poor.

Hawaii asphalt roads exhibit higher IRI and fatigue cracking distress values than rutting and environmental cracking. Hawaii's roads experience a significant difference in deterioration when compared to the continental US. There is limited rutting because of the significantly lower truck volumes. Asphalt cracking is also delayed in comparison to the continent. Asphalt mix designs generally contain 2% more oil than on the continent. Ultra violet radiation is lower in Hawaii when compared to the Western US. The higher asphalt content and the lower UV delays the onset of cracking. The contractor displayed results for both original and proposed OCI values in Numetric Workbooks. Based on the analysis, PFES 2.0 used the weight under Proposal 3. PFES 2.0 weights fatigue cracking (see 3.6 discussion below)

FIGURE 2.B | REVIEW CONCRETE OCI

Distress	Existing	Proposal 1	Proposal 2	Proposal 3
Ride	0.1	0.35	0.5	0.6
Jt. Spall	0.35	0.25	0.15	0.15
Faulting	0.1	0.15	0.1	0.1
Rut	0.45	0.25	0.25	0.15

PCC OCI REVIEW

Generally, Hawaii's concrete interstates are rough. While they exhibit slab cracking, faulting and spalling the predominate failure is the very high IRI (International Roughness Index). Similar to the asphalt OCI discussion, the PCC proposed weighing are displayed both the original and proposed OCI values. Based on analysis PFES 2.0 for PCC used the weighting of Proposal 3.

3.3 | MAP 21 CONDITION

Overview: In addition to OCI condition each section is classified as Good, Fair, or Poor using the Map 21 standards. Map 21 categorizes each of the following components into G/F/P to determine the overall condition:

1. Ride (IRI)
2. Cracking Percent as specified by HPMS
3. Rutting in the case of asphalt or Faulting in the case of Concrete.

All three components above must be in good condition for a section to be considered good. If at least 2 of the 3 components are Poor then the section is considered Poor. All other combinations are considered Fair.

FIGURE 3 | PAVEMENT REPAIR

Roads with >2,000 AADT	Average Normalized Environmental & Fat Crack
Pavement Repair	**2/3 Fat, 1/3 Envir.**
2%	<90
4%	<84
6%	<78
8%	<71
10%	<65

3.4 | PAVEMENT REPAIR (PR)

PFES 2.0 incorporated pavement repair. The timeframe between preservation treatment on "sections" may result in roads needing pavement repair before final asphalt surfacing takes places. Generally, PR includes excavating highly distressed pavement of a depth of no more than 6 inches. The excavated area is filled with 4" of asphalt concrete base (ACB), with the final lift being 2" of Mix 4 asphalt. PFES 2.0 used normalized fatigue and environmental cracking to estimate the percent of the surface to be excavated. The model recommends a weighting of 2/3 fatigue cracking to 1/3 environmental cracking.

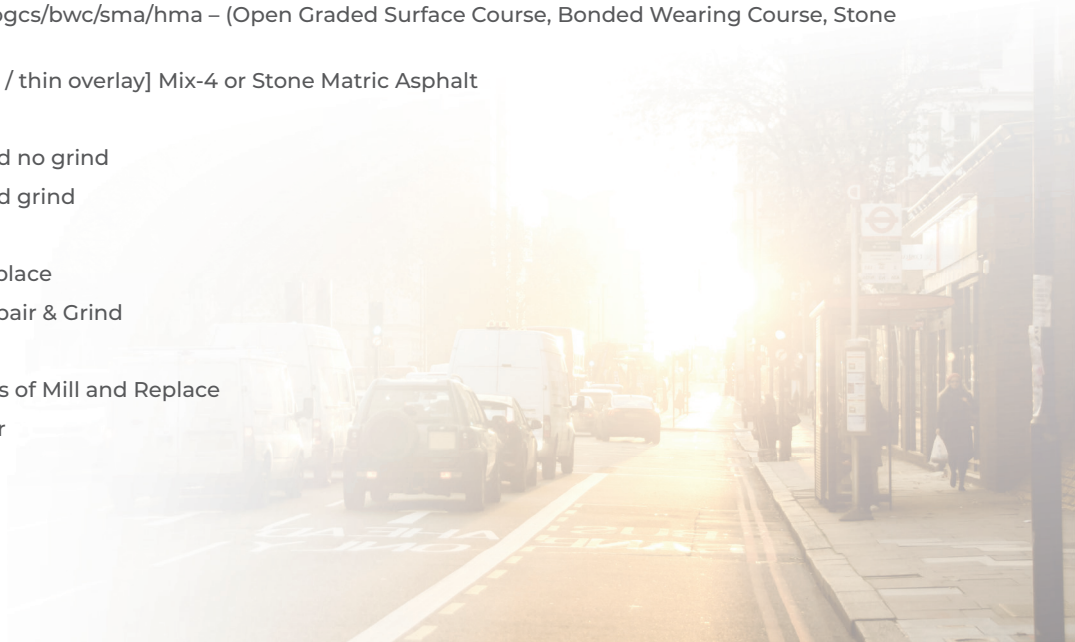
3.5 | TREATMENT TYPES AND RECOMMENDATIONS DUE TO CONDITION

Overview: Recommendations based on condition were made using the normalized road condition attributes discussed in section A of Transformations. The potential recommendations are comprised of preservation treatments, minor rehabilitations, and major rehabilitations. For recommendation due to condition logic see Figure 4 below.

FIGURE 4 | RECOMMENDATION DUE TO CONDITION

Surface	Treatment	Indexes
	No recommendation	Ride, Rut, Env Crk, and Fat Crk >=80
Asphalt	Low Volume Crack Seal	Fat Crk & Rut >= 50 and Ride >= 30 and AADT<2000
	Low Volume Crack Seal and Repair	Fat Crk or Rut < 55 or Ride < 40 and AADT<2000
	Seal- Low (chip)	Ride, Rut & Env Crk >= 70 and Fat Crk >=75 and Urban Code=Rual
	Seal - Med (Micro)	Ride, Rut & Env Crk >= 70 and Fat Crk >=75 and Urban Code=Small Urban
	Seal - High (1" typically ogcs/bwc/sma/hma)	Ride, Rut & Env Crk >= 70 and Fat Crk >=75 and Urban Code=Urban
	Functional Repair [1.5" / thin overlay]	Ride, Rut or Env Crk < 70 and Fat Crk >=70
	Minor Rehab [2 to 4" Mill & Replace]	Ride, Rut or Env Crk < 60 or Fat Crk <75 and Fat Crk >=60
	Major Rehab [> 4"]	Fat Crk <=55
Concrete	Repair (clean and reseal jts., spall & partial depth) & No Grind	70< Spalling <90
	Repair (clean and reseal jct., spall & partial depth) & Grind	70<IRI<90
	Minor Rehab [Slab Replace, Repair & Grind]	60< Spalling, Faulting <70 and 60< Slab Cracking <85 and 40<IRI<50
	Major Rehab [Full Depth Repair]	30< Spalling, Faulting <30 and 40< Slab Cracking <60 and 40<IRI<40

1. Preservations:
   a. Asphalt:
      i. Low Volume Crack Seal
      ii. Low Volume Seal Crack and Soft Spot Repair
      iii. Seal Low-Chip seal
      iv. Seal Medium-Micro
      v. Seal High- 1" typically ogcs/bwc/sma/hma – (Open Graded Surface Course, Bonded Wearing Course, Stone Matrix Asphalt, Mix -4)
      vi. Functional Repair [1.5" / thin overlay] Mix-4 or Stone Matric Asphalt
   b. Concrete:
      i. Spall, partial depth, and no grind
      ii. Spall, partial depth, and grind
2. Minor Rehabilitations:
   a. Asphalt: 4 inch Mill and Replace
   b. Concrete: Partial Depth Repair & Grind
3. Major Rehabilitation:
   a. Asphalt: More than 4 inches of Mill and Replace
   b. Concrete: Full Depth Repair



3.6 | PFES 2.0 TREATMENT TYPES AND RECOMMENDATIONS

DUE TO TIME

HDOT road projects generally don't have smoothness specifications. Newly constructed roads can be very rough. A time component was added for PFES 1.0. The time component either forces or restricts treatments depending on the duration since the last treatment. These time recommendations were derived from the Utah Department of Transportation pavement cycles. A significant challenge is updating recent treatments. HDOT doesn't not have an integrated data warehouse where new treatments are loaded into PFES 1.0. Therefore, we recommend discontinuing project selection due to time. Reference of what thresholds were used for this recommendation can be found in Recommendation Due to Time table under Figure 5 below.

FIGURE 5 | RECOMMENDATION DUE TO TIME

Surface	Treatment	Time
	No recommendation	<4
Asphalt	Low Volume Crack Seal	>4
	Low Volume Crack Seal and Repair	>4
	Seal- Low (chip)	>7
	Seal - Med (Micro)	>8
	Seal - High (1" typically ogcs/bwc/sma/hma)	>10
	Functional Repair [1.5" / thin overlay]	>14
	Minor Rehab [2 to 4" Mill & Replace]	>18
	Major Rehab [> 4"]	>22
Concrete	Repair (clean and reseal jts., spall & partial depth) & No Grind	>10
	Minor Rehab [Slab Replace, Repair & Grind]	>18
	Major Rehab [Crack & Seat / Rubble with HMA]	>22

PFES 2.0

PFES 2.0 recognized that Hawaii's roads can be rough, both newly paved roads and older pavement sections. PFES 2.0 assumed that sections exhibiting roughness but not cracking have been recently paved (within the last 7 to 10 years). Cracking is generally the first indication of distress. PFES 2.0 recommended crack sealing when either fatigue or environmental cracking drop below 98 and are greater than 70. The modeling does not address rough roads until normalized IRI values are less than 75.

Low Volume Roads - Limited or No Distress

AADT>2,000

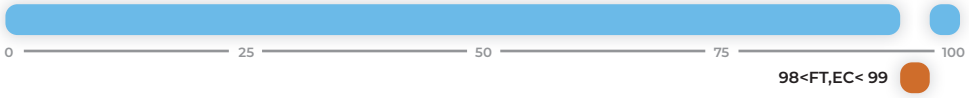
Condition: Section generally less than 10 years old. Very little cracking

Distress: Very limited cracking, or rutting. Ride can be smooth or rough

Distress Value: Cracking is greater than 98, but less than 99. Rutting is less than 1/2"

Reasoning: Fog seals slow aging of bituminous binder

Treatment: Agency might consider Fog Seal application. Test application rates as part of pavement design. Dense grade asphalts, for example Mix 4, might have applications < 1/10 gallon/sq. yard



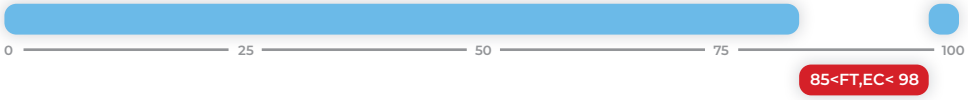
Low Volume Roads - Cracking

AADT< 2,000

Condition: Section generally 10 years old. Construction joints, environmental/fatigue cracking
Distress: Cracking

Fatigue Cracking (FC) & Environmental Cracking (EC)
Values weighted 2/3 FC, 1/3 EC
Distress Value: Cracking is less than 98 but greater the 85

Treatments: Apply Crack Seal
Thin overlays permitted less than 100ft length
Maintenance crews pothole patch as needed



Low Volume Roads - Cracking and Rutting

AADT>2,000

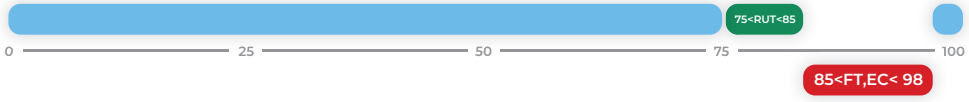
Condition: Section generally 10 years old. Moderate cracking an rutting

Distress: Cracking, and Rutting

Reasoning: Keep water from penetrating subsurface, rutting is a potential safety issue, fatigue cracking (FC) & environmental cracking (EC). Values weighted 2/3 FC, 1/3 EC

Distress Value: Cracking is less than 98 but greater than 85. moderate rutting (<1/2")

Treatment: Apply crack seal, wait one year before applying rutting repair. Thin overlay (1"SMA or Mix 4) or Microsurfacing (Traffic, Rainfall Dependent)



LEGEND

- NO TREATMENT
- FOG SEAL
- CRACK SEAL
- RUTTING
- OVERLAY
- PAVEMENT REPAIR
- MILL AND FILL

DISTRESS VALUES NORMALIZED
0 - 100

High Volume Roads - Limited or No Distress

AADT>2,000

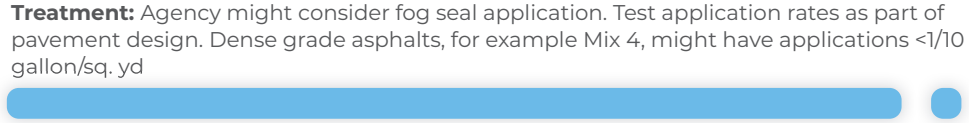
Condition: Section generally less than 10 years old. Very little cracking

Distress: Very limited cracking, or rutting. Ride can be smooth or rough

Distress Value: Cracking is greater than 98 but less than 99, rutting is less than 1/2"

Reasoning: Fog seals slow aging of bituminous binder

Treatment: Agency might consider fog seal application. Test application rates as part of pavement design. Dense grade asphalts, for example Mix 4, might have applications <1/10 gallon/sq. yd



High Volume Roads - Cracking

AADT>2,000

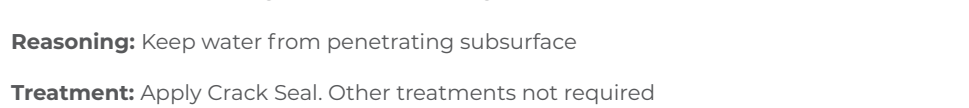
Condition: Section generally 10 years old. Construction joints, environmental/fatigue cracking

Distress: Cracking, Fatigue Cracking (FC) & Environmental Cracking (EC). Values weighted 2/3 FC, 1/3 EC

Distress Value: Cracking is less than 98 but greater the 85

Reasoning: Keep water from penetrating subsurface

Treatment: Apply Crack Seal. Other treatments not required



High Volume Roads - Cracking and Rutting

AADT>2,000

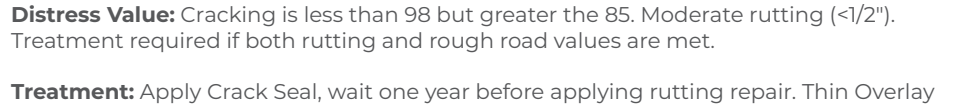
Condition: Section generally 10 years old. Moderate rutting.

Distress: Cracking, and Rutting

Reasoning: Keep water from penetrating subsurface, Rutting is a potential safety issue Fatigue Cracking (FC) & Environmental Cracking (EC). Values weighted 2/3 FC, 1/3 EC

Distress Value: Cracking is less than 98 but greater the 85. Moderate rutting (<1/2"). Treatment required if both rutting and rough road values are met.

Treatment: Apply Crack Seal, wait one year before applying rutting repair. Thin Overlay (1" SMA or Mix 4), Microsurfacing, or Chip Seal (Traffic, Rainfall Dependent). Pavement overlays that require pavement repair and crack seal are denoted with a "+" following the recommendation (e.g. Chip Seal+,SMA+, etc.) in Figure 6.



LEGEND

- NO TREATMENT
- FOG SEAL
- CRACK SEAL
- RUTTING
- OVERLAY
- PAVEMENT REPAIR
- MILL AND FILL

DISTRESS VALUES NORMALIZED
0 - 100

High Volume Roads - Cracking, Pavement Repair, Moderate Roughness I

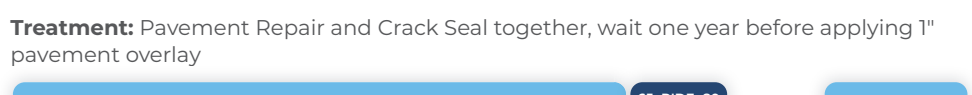
Condition: Section since last treatment generally older than 10 years. Wheel path cracking appearing. Ride is moderately rough

Distress: Cracking, Pavement Repair (Wheel Path Distress) Rough Ride

Reasoning: Keep water from penetrating subsurface. Assume rough roads from age, wear and tear, and not original construction

Distress Values: Fatigue Cracking in the wheel path will require Pavement Repair (also known as Pavement Recon.) Pavement Repair percent (%) dependent on fatigue distresses. Cracking is less than 85 but greater than 70. Fix if ride is less than 75 but greater than 65. Treatment required if both cracking (either environmental or fatigue) and rough road values are met.

Treatment: Pavement Repair and Crack Seal together, wait one year before applying 1" pavement overlay



Roads with less than 2,000 AADT are modeled for roughness I. Roads will not be prioritized because of funding. Roads will be shown on dashboard as "unfunded category."

High Volume Roads - Cracking, Pavement Repair, Moderate/Severe Roughness II

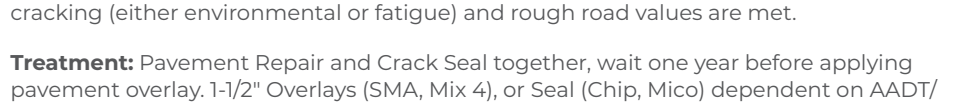
Condition: Section since last treatment generally older than 10 years. Wheel path cracking. Ride is moderately to severe rough road

Distress: Cracking, Pavement Repair (Wheel Path Distress) Rough Ride

Reasoning: Keep water from penetrating subsurface. Assume rough roads from age, wear and tear, and not original construction

Distress Values: Fatigue Cracking in the wheel path will require Pavement Repair (also known as Pavement Recon.). Pavement Repair percent (%) dependent on fatigue distresses. Cracking is less than 85 but greater than 70. Fix ride if less than 65. Treatment required if both cracking (either environmental or fatigue) and rough road values are met.

Treatment: Pavement Repair and Crack Seal together, wait one year before applying pavement overlay. 1-1/2" Overlays (SMA, Mix 4), or Seal (Chip, Mico) dependent on AADT/ Rainfall values. Pavement overlays that require pavement repair and crack seal are denoted with a "+" following the recommendation (e.g. Chip Seal+,SMA+, etc.)



Roads with less than 2,000 AADT are modeled for roughness II. Roads will not be prioritized because of funding. Roads will be shown on dashboard as "unfunded category."

FIGURE 6 | RECOMMENDATION

Application	AADT	Truck
Slurry	<4,000	<200
Chip	<8,000	<500
Micro	<15,000	<2,000
SMA	>15,000	>2,000

LEGEND

- NO TREATMENT
- FOG SEAL
- CRACK SEAL
- RUTTING
- OVERLAY
- PAVEMENT REPAIR
- MILL AND FILL

DISTRESS VALUES NORMALIZED
0 - 100

Minor Rehabilitation

High Volume Roads - Severe Wheel Path Cracking, Pavement Repair, Moderate/ Severe Roughness

AADT>10,000

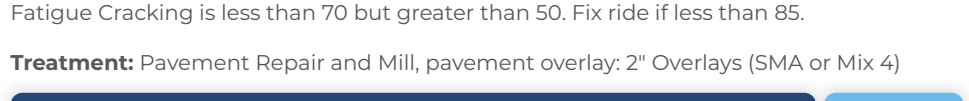
Condition: Section since last treatment generally older than 15 years. Rough road and wheel path cracking (fatigue) are due to age

Distress: Pavement Repair (Wheel Path Distress) and Rough Ride

Reasoning: The following treatment recommendation is triggered if both roughness and fatigue values are reached. Pavement Repair to fix fatigued areas (up to 6"). Mill up to 2" and replace with up to 2" Mix 4 or SMA. Funding Limitation restricted to sections of AADT> 10,000

Distress Values: Fatigue Cracking in the wheel path will require Pavement Repair (also known as Pavement Recon.). Pavement Repair percent (%) dependent on fatigue distresses. Fatigue Cracking is less than 70 but greater than 50. Fix ride if less than 85.

Treatment: Pavement Repair and Mill, pavement overlay: 2" Overlays (SMA or Mix 4)



AADT <10,000 roads will not be prioritized because lack of funding but will be shown on dashboard as "Unfunded Category."

Major Rehabilitation

High Volume Roads - Severe Wheel Path Cracking, Pavement Repair, Moderate/Severe Roughness

AADT>10,000

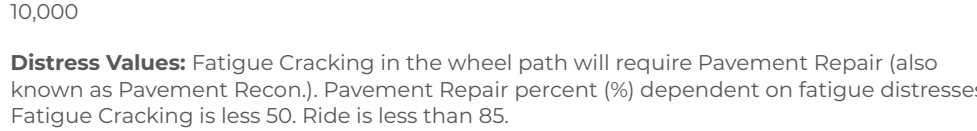
Condition: Section since last treatment generally older than 20 years. Rough road and wheel path cracking (fatigue) are due to age

Distress: Pavement Repair (Wheel Path Distress) and Rough Ride

Reasoning: The following treatment recommendation is triggered if both roughness and fatigue values are reached. Pavement Repair to fix fatigued areas (up to 6"). Mill up to 4" and replace with up to 2" Mix 4 and 2" SMA. Funding Limitation restricted to sections of AADT> 10,000

Distress Values: Fatigue Cracking in the wheel path will require Pavement Repair (also known as Pavement Recon.). Pavement Repair percent (%) dependent on fatigue distresses. Fatigue Cracking is less 50. Ride is less than 85.

Treatment: Pavement repair and mill. 4" overlays (1-1/2" SMA, 2-1/2" Mix 4)



AADT <10,000 roads will not be prioritized because lack of funding but will be shown on dashboard as "unfunded category."

LEGEND

- NO TREATMENT
- FOG SEAL
- CRACK SEAL
- RUTTING
- OVERLAY
- PAVEMENT REPAIR
- MILL AND FILL

DISTRESS VALUES NORMALIZED
0 - 100

Concrete

PRESERVATION

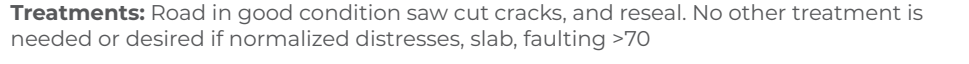
High Volume Roads - Reseal Joints

AADT>2,000

Condition: Sections generally 10 years old. Joint deterioration (jct. spalling), little faulting, slab cracking, rutting, ride can be be rough.

Distress Value: Joint spalling is less than 90 but greater the 70

Treatments: Road in good condition saw cut cracks, and reseal. No other treatment is needed or desired if normalized distresses, slab, faulting >70



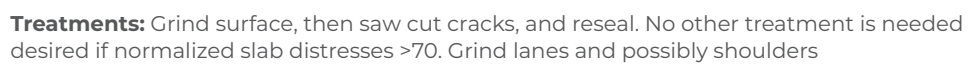
High Volume Roads - Reseal Joints, Grind Surface

AADT>2,000

Condition: Section generally 15 years old. Joint deterioration (jct spalling), and faulting. Minimal slab cracking, rutting, ride

Distress Value: Joint spalling is less than 90 but greater the 70 Faulting is less than 70 but greater than 60

Treatments: Grind surface, then saw cut cracks, and reseal. No other treatment is needed or desired if normalized slab distresses >70. Grind lanes and possibly shoulders



Minor Rehabilitation

High Volume Roads - Partial Depth Repair and Reseal Joints

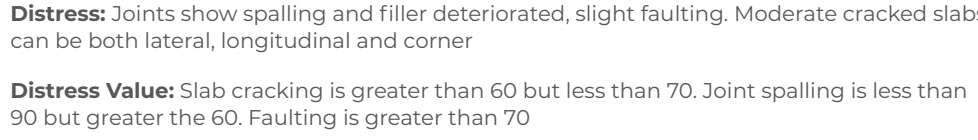
AADT>2,000

Condition: Condition: Section generally 15 - 20 years old. Slab cracking, corner breaks appearing, ride is rough but slight faulting

Distress: Joints show spalling and filler deteriorated, slight faulting. Moderate cracked slabs can be both lateral, longitudinal and corner

Distress Value: Slab cracking is greater than 60 but less than 70. Joint spalling is less than 90 but greater the 60. Faulting is greater than 70

Treatments: Repair cracked slab (partial depth repair) saw cut cracks and reseal. No grinding typically needed



LEGEND

NO TREATMENT

CONCRETE JTS SEAL

CONCRETE GRIND

SLAB REPAIR

DISTRESS VALUES NORMALIZED
0 - 100

Major Rehabilitation

High Volume Roads - Full Depth Repairs, Reseal Jct, Grind

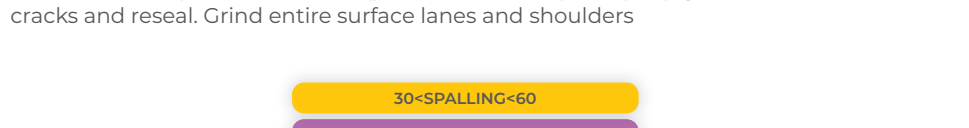
AADT>2,000

Condition: Section generally 20 years old. Slab cracking, corner breaks, ride is rough with faulting and joint spalling

Distress: Slabs have extensive cracks. Joints have spalling and filler deteriorated, moderate to severe faulting

Distress Value: Slab cracking is less than 60. Joint spalling is less than 60 Faulting is less than 60

Treatments: Repair cracked slab (partial and full depth repair), grind then surface saw cut cracks and reseal. Grind entire surface lanes and shoulders



LEGEND

NO TREATMENT

CONCRETE JTS SEAL

CONCRETE GRIND

SLAB REPAIR

DISTRESS VALUES NORMALIZED
0 - 100

Reconstruction

High Volume Roads - Crack and Seat or Rubblization

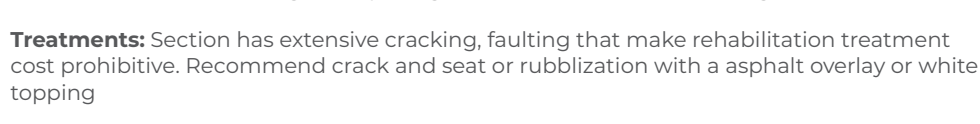
AADT>2,000

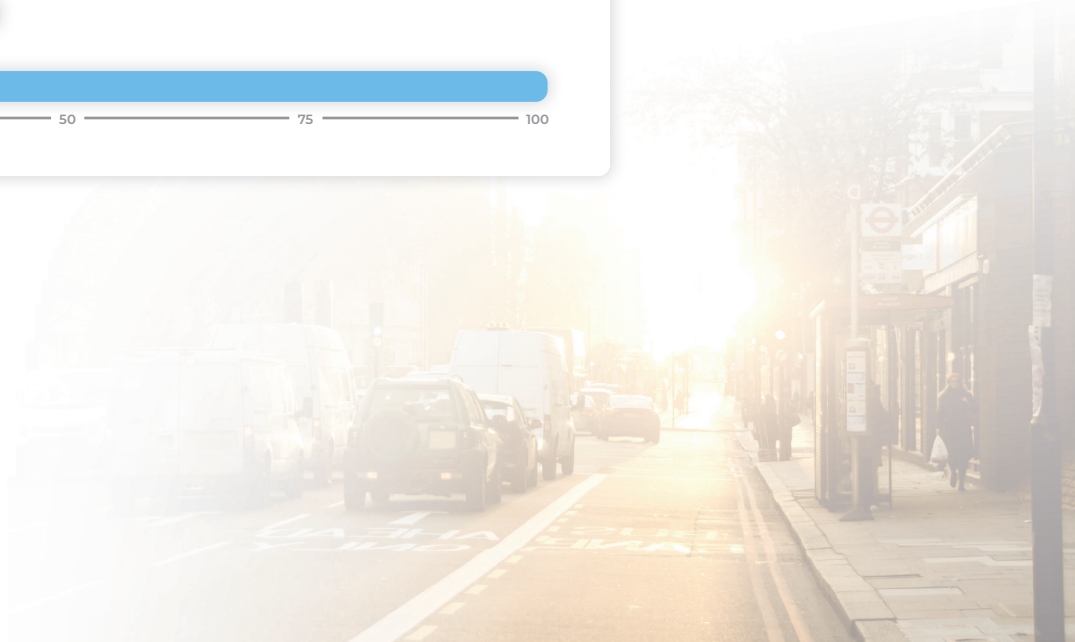
Condition: Section generally 20 years old. v Very rough road and may have extensive slab cracking, corner breaks, with faulting and joint spalling

Distress: Slabs may have extensive cracks. Joints have spalling and filler may have deteriorated, moderate to severe faulting

Distress Value: IRI, faulting, and spalling are less than 30. Slab Cracking is less than 40

Treatments: Section has extensive cracking, faulting that make rehabilitation treatment cost prohibitive. Recommend crack and seat or rubblization with a asphalt overlay or white topping





3.7 | PREPARATION RECOMMENDATION DUE TO CONDITION

All preservation and functional repair recommendations would also have a preparation treatment done to a PFES section in the years leading up to the recommendation. This field is designed to notify the user what type of preparation is required and when it should be applied before carrying out the recommendation. Preparation treatments are included for recommendations based on condition. Does not apply to PFES 2.0 recommendations. Preparations are done for all treatments that do not involve milling of pavement.

3.8 | ADJUSTED OCI CALCULATION AND CONDITION CLASSIFICATION

Each recommendation selected by the condition based criteria provides specific improvements to each of the normalized condition attributes, shown in **Appendix 3**. These improved normalized values are calculated for a given recommendation and then an adjusted (improved) OCI value is calculated. The adjusted OCI values is later used to determine the benefit of applying a suggested recommendation to a PFES section.

3.9 | RECOMMENDATION AND PREPARATION COSTS DUE TO CONDITION

Each recommendation and preparation was estimated based on Hawaii's construction costs. The cost of each recommendation is summarized into the overall recommendation unit cost of dollars per square yard of roadway. The total cost is derived by joining the pavement surface area totals with the recommendation unit costs.

3.10 | TRAFFIC LOAD

HPMS AADT traffic counts from 2018 reporting were used to classify low volume roads and high volume roads. High volume roads were any roads that had passenger vehicle counts greater than or equal to 2000 or truck counts over 500. An additional volume classification of Interstate was assigned by using HPMS functional class data. Traffic load was used to assist in assigning low volume seal treatments. If multiple HPMS sections fell within a PFES section, the maximum traffic count from those sections was used.

FIGURE 6 | TRUCK TRAFFIC FACTOR

Proposed Traffic Factor (T.F.) *	**Trucks Volumes**			
	< 200 per day	< 500 per day	< 1000per day	> 1000 per day
T.F.	0.4	0.41	0.42	0.43

Truck traffic is generally considered the most significant factor that affects the life of the pavement section. All things being equal PFES 2.0 prioritized higher truck volumes roads. For example; if 2 sections are identical; same distresses, annual rainfall, recommendations, traffic volumes, etc. roads with the higher number of trucks will be prioritized first.

Understanding the Benefit Ranking - Traffic Factor: PFES 1.0 logic included a traffic factor to weight potential project based on traffic volumes. The traffic volumes are raised to 0.4 to prioritize project selection. The factor combines all traffic classifications into a single measure. PFES 2.0 added different truck volumes to the traffic factor. The analysis compared how different truck volumes, particularly on Hawaii's Interstates and roads around ports, affect project outcomes. PFES 2.0 recommended a sliding increase in the Traffic Factor* to depending on different truck volumes.

FIGURE 7 | RAINFALL*

Annual Rate	**Project Selection**	**PFES Logic**
X >50"	No Emulsion**	X> 50"
X<50"	Emulsion OK	X< 50"
		Chip & Slurry Seal
		Fog Seal

3.11 | PRESERVATION SELECTION/RANKING

Rainfall/Soils

PFES 2.0 incorporated different environmental factors within the model, including how annual rainfall varies across each island of the state. The program also incorporates how the general soil composition varies from island to island.

The different environments of Hawaii create modeling challenges. These challenges include extreme rainfall. Rainfalls can vary from 200 inches/year on the windward to less than 25 inches on the leeward side of each island. The existing subsoils is another variability from island to island. The soil differences may be attributed to the different ages of the islands, from the youngest – Hawaii to the oldest Kauai. The bearing capacity and life-cycle of the pavement is affected by both rainfall and subsoils.

FIGURE 8 | BEARING CAPACITY OF UNDERLYING SOILS

Soils	**Increase Weighting Factor for islands with Poor Soils**	**Weighting Factor**
Kauai	Poorest Soils	1.10
Oahu		1.05
Maui		1.00
Hawaii	Best Draining Soils	.95

Emulsions

Hawaii's high rainfall areas can pose a challenge to the applications of emulsion treatments. Emulsions require water evaporation. Oil and rock are left after the evaporation process. Heavy rainfall areas, limiting evaporation may pose a challenge during construction. HDOT has experienced premature slurry failures. This may have been a result of rain during the construction process. The model recommends that emulsion preservation types, such as, microsurfacing, chip and slurry seals be limited to areas of the islands experiencing less than 50 inches of rainfall annually.

Pavement Treatments and Truck Traffic

High volume truck traffic or high turning truck traffic can have varying negative effects on preservation treatments, specially chip seals, and slurry seals. PFES 2.0 restricted the use of these two seals to low truck volumes. PFES 2.0 also recommended that high cost treatment (SMA, Mix 4) being restricted to high volume roads, while also restricting low cost treatment (Chip, Slurry) to low volume roads. PFES 2.0 evaluated and incorporated proposal 2 into the model.

FIGURE 9 | PROPOSED TRAFFIC VOLUMES*

Combined AADT	Truck Volumes		
AADT	**Proposal 1**	**Proposal 2**	**Treatments**
>15,000	> 2,000	>1000	Stone Matric Asphalt (SMA) or 2" Overlay
<15,000 >8,000	> 1000 & <2000	>300 & <1000	Micro Surfacing
<8,000 >4,000	>200 & < 500	>100 & <300	Chip Seal
<4,000	< 200	<100	Slurry Seal

3.12 | PROJECT RANKING

Benefit Value

The benefit value for PFES 1.0 is the product of the change in OCI for the provided recommendation due to condition and the AADT for the section raised to 0.4. The benefit value of a PFES section was determined by taking the traffic volume with truck volumes raised from a value of 0.4 to 0.43 (depending on truck volumes) multiplied by the change in OCI value for the provided recommendation. This function mimics the benefit calculation used in UDOT.

Benefit/Cost Ratio Due To Condition

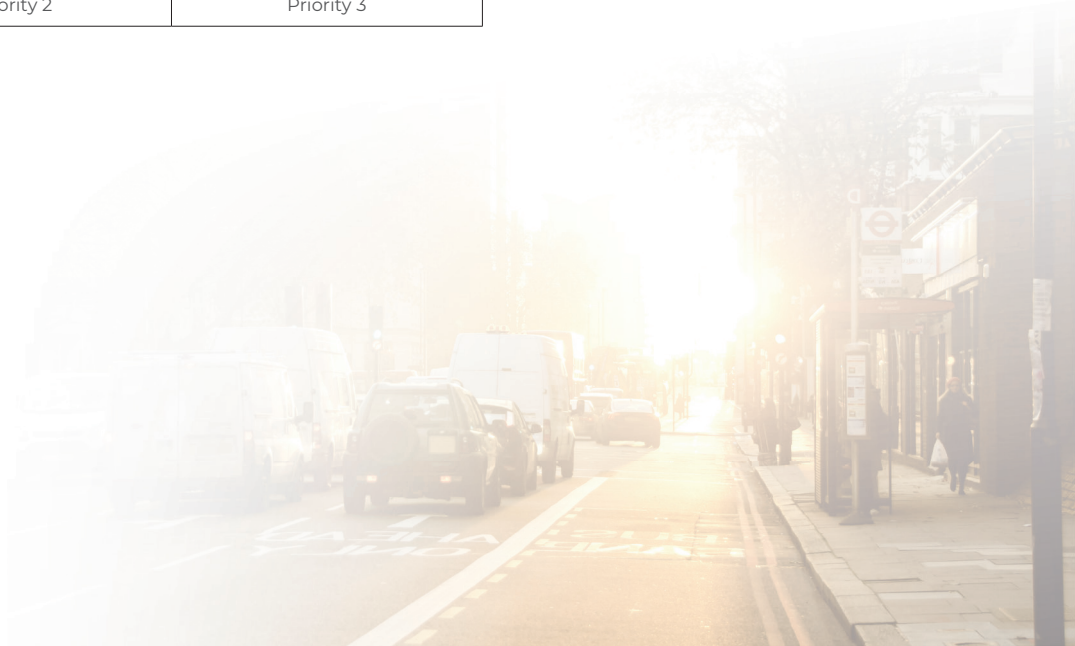
The previously calculated Benefit is divided by the Cost of the recommendation. Benefits/Cost fields exist for PFES 1.0, PFES 2.0, and PFES 2.0 Soil weighting

Priority Ranking

Sections and the predicted recommendations are divided into 3 tiers of prioitization. Prioritization levels are driven by traffic volumes vs the recommended level of traffic to justify the recommendation and also if the section is on the national highway system (nhs).

FIGURE 10 | PRIORITY RANKING

	Preservation>2000 AADT or Minor/Major Rehab>10000	Preservation<2000 AADT or Minor/Major Rehab<10000
NHS	Priority 1	Priority 2
Non-NHS	Priority 2	Priority 3



4.1 | FILTER SIDE BAR AND FILTER HEADER

The Filter column to the right side of the main PFES workbook is designed to make broad filters to all tabs within the PFES workbook. It's recommended to filter the Island of interest first and then apply any other desired filters as needed. To edit the current filter combination, you can either select the option to be removed from the right filter column or delete the tag from the filter bar at the top of the workbook.

4.2 | OVERVIEW PAGE

The overview page provides a map displaying the condition of the PFES sections, the stats of the overall condition of the sections, and stats for the normalized roadway characteristics. The map is currently configured so that green corresponds with Good condition, yellow with Fair, and red with Poor. All the Charts below the map are intended to provide a summary of the road condition form a user provided subset of PFES sections. This can be useful in finding trends in common failure types, distress common to regions, deterioration trends, etc.

4.3 | MAP21 PAGE

The Map21 tab has a map that displays the condition of the PFES section in accordance with the Map21 guidance described on entry C of the Transformation section. The graphs below the map provide a breakdown of the roadway characteristics of Map21 for asphalt and concrete pavements.

4.4 | RECOMMENDATIONS PAGE

The recommendations page is primarily broken down into recommendations based on condition on the left side of the page. The top of the page has a distribution of recommendations based on miles of roads.

The remaining graphs depict the cost of the treatment families. This page allows the user to either select specific types of treatments they would like to see implemented or to see what types of treatments result from filter down PFES sections spatially, choosing high B/C ratios, specific functional classifications of roads, etc.

PFES 2.0 included prioritized recommendations for a three (3) year period. The highest B/C projects are recommended for the first year. The next ranked projects for the 2nd year and the least ranked for the 3rd year. The recommendation recognizes that limited funding restricts Hawaii's ability to complete all projects in one year. PFES assumes that the HDOT will allocate the same amount for each year of the 3 year period.

4.5 | TABLE PAGE

The top of the table page contains the raw data displayed throughout the rest of the workbook. This table can be exported to a comma-separated value text file (CSV) to be used in excel or other spreadsheet software for further analysis. The table displays the current filtered data just like the rest of the workbook which can aid in creating list of potential projects given specific conditions. Below the table are graphs showing the benefit/cost ratios for PFES sections based on condition recommendations and time recommendations.

OCI PROP TAB:

Three OCI propositions mentioned in section 3.2 are displayed in both map form and also a chart displaying Good, Fair, and Poor roads using the associated weighting.

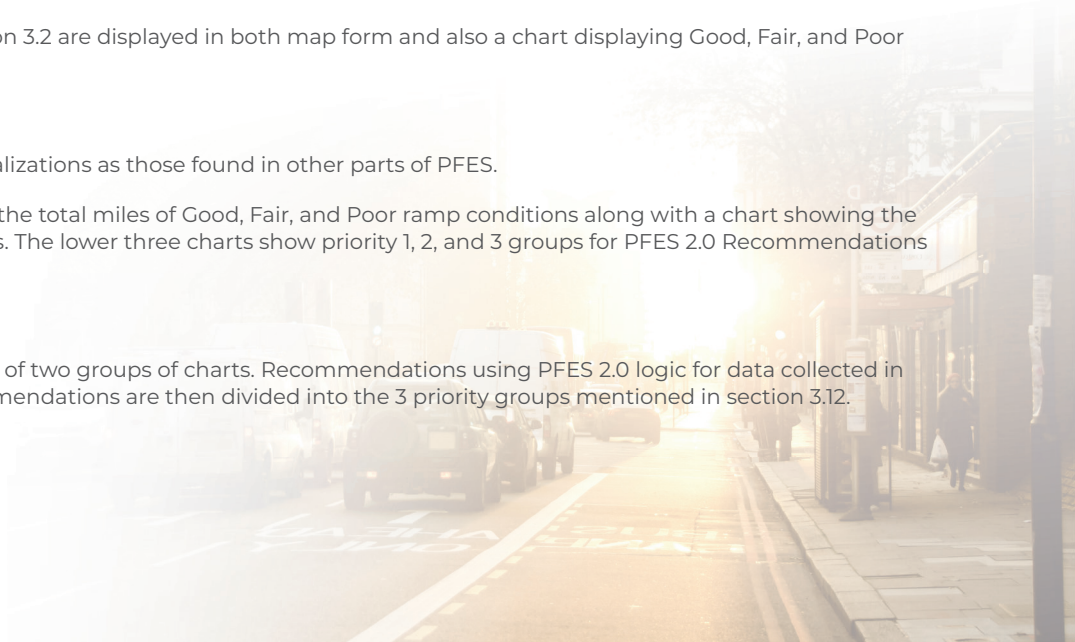
RAMPS TAB:

Overall the ramps tab provides similar visualizations as those found in other parts of PFES.

At the top of the page are graphs showing the total miles of Good, Fair, and Poor ramp conditions along with a chart showing the Benefit/Cost project prioritization for ramps. The lower three charts show priority 1, 2, and 3 groups for PFES 2.0 Recommendations for ramp data collected in 2019.

RECOMMENDATION 2.0 TAB:

The Recommendation 2.0 tab is comprised of two groups of charts. Recommendations using PFES 2.0 logic for data collected in 2019 and data collected in 2017. The recommendations are then divided into the 3 priority groups mentioned in section 3.12.



5.1 | PFES SECTION UPDATE

1. Alter the existing PFES section list with desired changes and update the PFES_SECTIONS table in SQL.
2. Any new sections will not have pavement data

5.2 | PAVEMENT DATA UPDATES

1. Tenth mile pavement data will need to be taken from the vender and replace the outdated data in the PFES_MANDLI table.
   a. A JOIN_Name will need to be created to be able to join multiple cycles of data to a single LRS shapefile. The join name is comprised of:
      i. Island
      ii. Route
      iii. Direction
   b. Cycle will also need to be added to this table to represent the collection year.
2. The rest of the views should properly update. It may be best to look at some of the data that was updated and verify that the views are behaving normally. Below are the views that help in creating the final PFES_CONDITION view.
   a. PFES_SECTIONID_ASSIGN: view, assigns each row of the MANDLI table a section if it is completely within the PFES section.
   b. PFES_MANDLIMATCH_ASSIGN: view, splits rows from the Mandli table that straddle two HDOT sections and provides the percentage.
   c. PFES_PKEY_SECTION_UNION: view, union of all the rows from PFES_SECTIONID_ASSIGN and PFES_ MANDLIMATCH_ASSIGN making a full list of rows from the Mandli table that have matching route in the sections table.
   d. PFES_CONDTION: view, combines the individual entries into PFES sections. Some columns are averaged while others are summed. For pavement condition report records that were partially in two PFES sections the values of that record were multiplied by the percentage reflecting how much of the record resides in the specified PFES section.
3. Plot table data over Hawaii LRS
   a. Take tabular data from the PFES_CONDITION view and overlay on the latest Hawaii LRS.
   b. Use the join_name as the route to join with. Chose the BMP and EMP as the start and stop of each plotted section, respectively.
   c. ID any pavement sections that didn't join to the LRS
   d. Verify any gaps in the pavement data with the LRS
4. Update the existing HAWAII PFES CONDTION table on Numetric with a zipped version of the shapefile previously mentioned.

5.3 | TRAFFIC COUNT UPDATES

1. Extract the traffic sections from the most recent HPMS submittal. Data_Item="AADT"
2. Import HPMS traffic counts to the PFES_AADT table and verify that all PFES sections have an AADT associated with them. Below are the views used to get the AADT data assigned to a PFES section.
   a. PFES_AADT: table, houses the most recent set of HPMS traffic count data.
      i. JOIN_NAME will need to be added to the imported data. Join name is comprised of:
         - Island
         - Route
         - Direction
   b. PFES_AADTMATCH_ASSIGN: view, assigns each row of the AADT table to a section and parses AADT sections into multiple pfes sections.
   c. PFES_AADT_SECTIONID_ASSIGN: view, assigns sections that completely contains an AADT record.
   d. PFES_AADT_UNION: view that performs a union (i.e. combines rows from) PFES_AADTMATCH_ ASSIGN and PFES_AADT_SECTIONID_ASSIGN
   e. PFES_AADT_FINAL: average AADT data is calculated for each PFES section by performing a weighted average using the section length and AADT count. The minimum and maximum AADT is also calculated for each PFES section as well.

5.4 | SURFACE AREA UPDATES

1. Surface area reports will need to be generated at 0.01 mile intervals and then placed into the PFES_SURFACEAREA table. The data is then combined into each PFES section in the PFES_SA_ SECTION_ASSIGN view.
    a. In the PFES_SURFACEAREA table a JOIN_NAME will need to be added. The JOIN_NAME field is made of:
        i. Island
        ii. Route
        iii. Direction
    b. Also in the surface area table the BMP and EMP values will need to be switched for all negative direction routes.
2. Export a CSV from this view and update the HAWAII PFES SURFACE AREA table in Numetric.

5.5 | COST UPDATES

1. Currently cost updates will need to be made to Transformations in the Hawaii PFES Condition dataset on Numteric.
2. The transformations that house the cost information are:
    a. RECOMMENDATIONDUE TO CONDITION COST
    b. RECOMMENDATION DUE TO TIME COST
3. The costs for each recommendation is based on assumed costs for processes/materials. Items like traffic control, preliminary engineering, and mobilization were assumed percentages of the total project cost. Each treatment received a dollar per square yard of pavement unit price, $/sq. yd.

APPENDIX 2 | LOGIC

MANDLI COMMUNICATIONS

	Traffic Volumes	Distresses	Measures	Treatments	Measures		Notes
Asphalt Pavement							
Preservation							
	Low Volume	Little Distress	Fat Cracking	Consider Fog Seal	98<FC<99	Or	Sections displaying little cracking distress consider fog seals
			Envir Cracking		98<EC<99		
		Cracks		Crack Seal			Low Volume Roads (AADT <2,000)
			Fat Cracking		85>FC<98	Or	Small 100 ft long spot overlay permitted
			Envir Cracking		85>EC<98		
		Rutting		Crack/Micro seals/ SMA			
			Fatigue Cracking		85<FC<98	Or	Microsurfacing or SMA (1") is most appropriate treatment for rutting with minor fatigue and environmental cracking, 85>FT,EC<98. Use SMA in high rainfall areas, Micro in low rainfall areas. Crack seal a year or two before as needed.
			Environmental Cracking		85<EC>98	And	
			Rutting		75<Rut<85		
	High Volume	Little Distress	Fat Cracking	Consider Fog Seal	FC>98	Or	Sections displaying little cracking distress consider fog seals
			Envir Cracking		EC>98		
		Cracks		Crack Seal			
			Fat Cracking		85<FC<98	Or	Crack Sealing
			Envir Cracking		85<EC<98		
		Rutting		Crack/Micro Seals/ SMA			
			Fatigue Cracking		85<FC<98	Or	Microsurfacing or SMA (1") is most appropriate treatment for rutting with minor fatigue and environmental cracking, 85>FT,EC<98. Use SMA in high rainfall areas, Micro in low rainfall areas. Crack seal a year or two before as needed.
			Environmental Cracking		85<EC>98	And	
			Rutting		75<Rut<85		
		Roughness I		SMA/Overlay (Mix 4)/Chip/Micro			
			Fat Cracking		70<FT<85	Or	Crack seal a year or two before as needed. Pavement Repair % as needed (See Workplan). 1" SMA/Overlay, includes as part of PFES 2.0 Pavement Repair. Urban areas with Curb and Gutter mill next to curb 5' by 1" depth
			Enviro Cracking		70<FT<85	And	
			Ride		65<R<75		
			Pavement Repair	As Required			
							Sections with AADT <2000, modeled but not ranked prioritized. Dashboard will note lack of funding
		Roughness II		SMA/Overlay (Mix 4)/Chip/Micro			
			Fatigue Cracking		70<FT<85	Or	Mill and fill 1-1/2" put back SMA. Mill 1" in areas (lower AADT) replace with either Micro or Chip. Crack seal a year or two before as needed. Urban areas with Curb and Gutter mill next to curb 5' by 1-1/2" depth.
			Environmental Cracking		70<FT>85	And	
			Ride		R<65		
			Pavement repair	As Required			
							Sections with AADT <2000, modeled but not ranked prioritized. Dashboard will note lack of funding
Minor Rehab							
		Wheel Path Fatigue/ Roughness		SMA.Overlay (Mix 4)			
			Fat Crack	Mill/Fill	50<F<70	And	2" Pavement Rehab, 2" SMA, or Mix 4
			Ride		R<80		
			Pavement Repair	As Required			
							Sections with AADT <10000, modeled but not ranked prioritized. Dashboard will note lack of funding
Major Rehab							
		Wheel Path	Fat Crack	Mill/Fill	F<50	And	4" pavement rehab, 1-1/2" SMA, 2-1/2" Mix 4
			Ride		R<80		
			Pavement Repair	As Required			
							Sections with AADT <10,000, modeled but not ranked prioritized. Dashboard will note lack of funding

	Traffic Volumes	Distresses	Measures	Treatments	Measures		Notes
Jointed Concrete Pavement Logic							
Preservation							
	High Volume	No Treatment			S>90	And	
					F>70	And	
					R>70	And	
					Sl Ck >85		
		Reseal Cracks		Reseal Jts., Repair Cracks			
			Spalling		70<S<90		Road in good consition, clean and reseal cracks
		Rough Road		Grind, Reseal Jts., Repair Cracks			
			Ride		50<R<70		Grinding is required after cleaning and resealing cracks
Minor Rehab, Partial Depth Repair							
		Spalling		Reseal Jts., Repair Slabs			
			Spalling		60<S<70	Or	Partial depth repair required - generally 1/2 the depth or less
			Faulting		60<F<70	Or	Section might include slab cracking, faulting, and spalls. The ride is rough
			Ride		40<R<50	Or	Dowel Bar retro fit and slab stabilization may be required
			Slab Cracking		60<Sl.Cr.<85		Grinding is required
Major Rehab, Full Depth Repair							
				Reseal Jts., Repair Slabs, Dowel Bar Retro, Grind			
		High Level of Distress	Spalling		30<S<60	Or	Full depth repair required for individual concrete panels
			Faulting		30<F<60	Or	Sections might have spalling and faulting of joints
			Slab Cracking		40<Sl.Cr.<60	Or	Grinding required to reestablish smoother surface
			Ride		30<R<40		Possible dowel bar retro fit to re-establish load transfer.
Reconstruction							
			Possible Crack and Seat, or Rubblization				
	Extensive	Spalling		S<30	Or		Section might have broken slabs, and might include faulting, spalling or rough ride
	Damage	Faulting		F<30	Or		Major Rehabilitation not justified. Agency might consider rebuilding section
		Ride		R<30	Or		Candidates might include: crack and seat or subblization
		Slab Cracking		Sl.Cr.<40			

APPENDIX 3 | ADJUSTED NORMALIZED FIELDS

ADJUSTED NORMALIZED FIELDS									
	Recommendation	**Fatigue Cracking Index**		**Env Cracking Index**		**Ride Index**		**Rutting Index**	
		Index		Index	Min	Index	Min	Index	Min
Asphalt	Crack Seal	2.5%		100		10%		10%	
	Crack Seal and Lane Level	3.5%		100		20%		20%	
	Seal- Low (chip)	2.5%		100		10%		10%	
	Seal - Med (Micro)	3.5%		100		20%		20%	
	Seal - High (1" typically ogcs/bwc/sma/hma)	5%		100		30%		30%	
	Functional Repair [1.5" / thin overlay]	5%		60%	85	25%	80	25%	80
	Minor Rehab [2 to 4" Mill & Replace]	30%		100		50%	90	50%	90
	Major Rehab [> 4"]	100		100		100		100	
Concrete		**Joint Spalling Index**		**Joint Faulting Index**		**Slab Cracking Index**		**Ride Index**	
		Index	Min	Index	Min	Index	Min	Index	Min
	Repair (clean and re-seal jts., spall & partial depth) & No Grind	35%	75	0%		0%		10%	
	Repair (clean and re-seal jct., spall & partial depth) & Grind	35%	75	55%	90	0%		55%	90
	Minor Rehab [Slab Replace, Repair & Grind]	35%	80	55%	90	35%	80	55%	90
	Major Rehab [Crack & Seat / Rubble with HMA]	100		100		100		100	

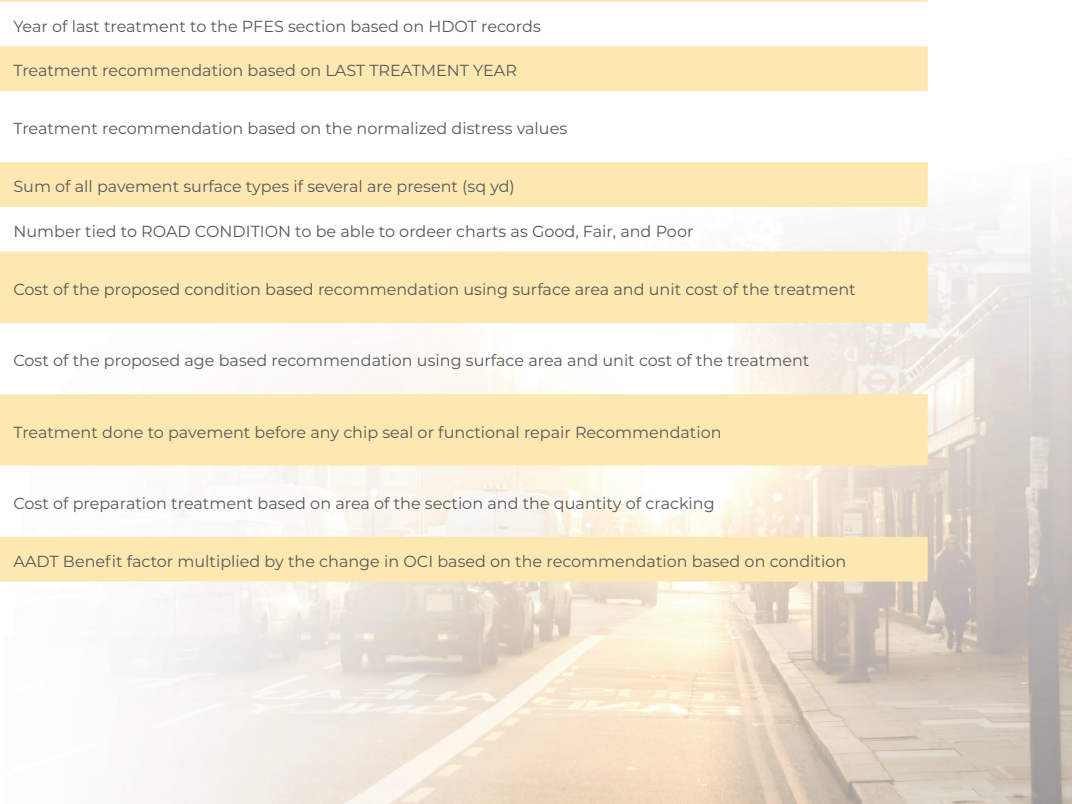
APPENDIX 4 | FIELD MAPPING DOCUMENT

FIELD	DESCRIPTION
HDOT SECTION	Hawaii used Section ID composed of ROUTE, BMP, and EMP
SECTIONID	Mandli used section ID composed of ISLAND, ROUTE, DIRECTION, and BMP
JOIN_NAME	Used for joining Mandli data and traffic data. Made of ISLAND, ROUTE, and DIRECTION
BMP	Begin Mile Point of PFES section using mandli mileage
EMP	End Mile Point of PFES section using mandli mileage
ISLAND	Island containing route
AVERAGE AADT COMBO	Average AADT of combo trucks from HPMS sections if multiple HPMS sections represent a PFES section
AVERAGE AADT	Average AADT from HPMS sections if multiple HPMS sections represent a PFES section
AVERAGE AADT SINGLE UNIT	Average AADT of single unit trucks from HPMS sections if multiple HPMS sections represent a PFES section
MAX AADT COMBO	Max AADT of combo trucks from HPMS sections if multiple HPMS sections represent a PFES section
MAX AADT	Max AADT from HPMS sections if multiple HPMS sections represent a PFES section
MAX AADT SINGLE UNIT	Max AADT of single unit trucks from HPMS sections if multiple HPMS sections represent a PFES section
MIN AADT COMBO	Min AADT of combo trucks from HPMS sections if multiple HPMS sections represent a PFES section
MIN AADT SIGNLE UNIT	Min AADT of single unit trucks from HPMS sections if multiple HPMS sections represent a PFES section
MIN AADT	Min AADT from HPMS sections if multiple HPMS sections represent a PFES section
ROUTE	PFES route number or name
ROAD_TYPE	Road type designation State Route (SR), County Route (CR), Ramp (RMP), Frontage Road (FR),
DIRECTION	Inventory direction
FUNCTIONAL CLASS	Functional classification of road based on HDOT HPMS data
AADT BENEFIT FACTOR	AADT raised to a power intended to provide greater weight to roads with higher traffic counts
TRAFFIC LOAD	Interstate, High volume (>2000 AADT or >500 trucks), and Low Volume (<2000 AADT or <500 trucks)
Asphalt Surface Area	Asphalt pavement area in PFES section (sq yd)
Concrete Surface Area	Concrete pavement area in PFES section (sq yd)
Gravel Surface Area	Gravel pavement area in PFES section (sq yd)
Combo Surface Area	Combination pavement area in PFES section (sq yd)
SURFACE TYPE	Surface type designated for the PFES section
LENGTH	Length of the PFES section (mile)
SUM LENGTH	Length all lanes within the PFES section (mile)
factor	Not used by Numteric. Atrifact of PFES creation process
CYCLE	Year of data collection
BLOCKS1	Low severity Block Cracking following LTPP definitions (sq ft)
BLOCKS2	Medium severity Block Cracking following LTPP definitions (sq ft)
BLOCKS3	High severity Block Cracking following LTPP definitions (sq ft)
FATS1	Low severity Fatigue/Alligator Cracking following LTPP definitions (sq ft)
FATS2	Medium severity Fatigue/Alligator Cracking following LTPP definitions (sq ft)
FATS3	High severity Fatigue/Alligator Cracking following LTPP definitions (sq ft)
LONGNWPS1	Low severity non-wheelpath longitudinal cracking length following LTPP definitions (ft)
LONGNWPS2	Medium severity non-wheelpath longitudinal cracking length following LTPP definitions (ft)
LONGNWPS3	High severity non-wheelpath longitudinal cracking length following LTPP definitions (ft)

FIELD	DESCRIPTION
PATCHS1	Low severity patching area following LTPP definitions (sq ft)
PATCHS2	Median severity patching area following LTPP definitions (sq ft)
PATCHS3	High severity patching area following LTPP definitions (sq ft)
TRANS1	Low severity transverse cracking count(2017)/ length(2018) following LTPP definitions (ft)
TRANS2	Median severity transverse cracking count(2017)/ length(2018) following LTPP definitions (ft)
TRANS3	High severity transverse cracking count(2017)/ length(2018) following LTPP definitions (ft)
POTHOLES	Pothole counts following LTPP definitions
RAVES1	Low severity raveling length (ft)
RAVES2	Median severity raveling length (ft)
RAVES3	High severity raveling length (ft)
REFLEC	Reflective cracking length (ft)
CONLONGS1	Low severity concrete longitudinal crack count
CONLONGS2	Medium severity concrete longitudinal crack count
CONLONGS3	High severity concrete longitudinal crack count
CONPATS1	Low severity patch count on concrete
CONPATS2	Medium severity patch count on concrete
CONPATS3	High severity patch count on concrete
CONTRANS1	Low severity concrete transverse crack count
CONTRANS2	Medium severity concrete transverse crack count
CONTRANS3	High severity concrete transverse crack count
TJDS1	Low severity transverse joint damage on concrete
TJDS2	Medium severity transverse joint damage on concrete
TJDS3	High severity transverse joint damage on concrete
DCS1	Low severity durability cracking slab count
DCS2	Medium severity durability cracking slab count
DCS3	High severity durability cracking slab count
CBS1	Low severity concrete corner break count
CBS2	Medium severity concrete corner break count
CBS3	High severity concrete corner break count
JOINTS	Transverse concrete joint count
FAULT_AVG	Average transverse joint faulting (in)
FAULT_LOW	Low severity transverse joint faulting count
FAULT_MED	Medium severity transverse joint faulting count
FAULT_HI	High severity transverse joint faulting count
IRI_AVERAG	Average international Roughness Index (IRI) from both wheelpaths (in/mile)
IRI_LT	International Roughness Index (IRI) of the left wheelpath (in/mile)
IRI_RT	International Roughness Index (IRI) of the right wheelpath (in/mile)
CF_AVG	Average cross fall or cross clope of lane (% slope)
CF_MAX	Max cross fall or cross slope of lane (% slope)

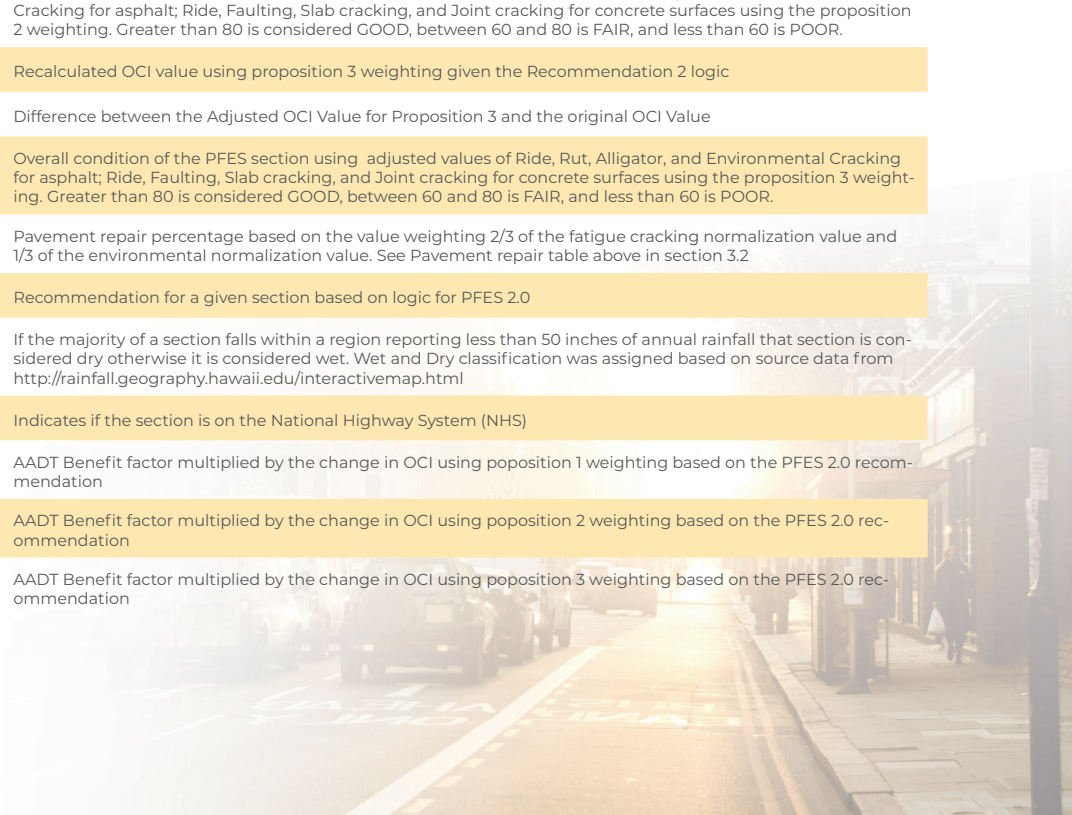
FIELD	DESCRIPTION
RUT_AVERAG	Average wheelpath rutting (in)
RUT_LT	Left wheepath rut depth (in)
RUT_RT	Right wheepath rut depth (in)
RUT1	Low severity rutting area following ASTM 6433 (sq ft)
RUT2	Medium severity rutting area following ASTM 6433 (sq ft)
RUT3	High severity rutting area following ASTM 6433 (sq ft)
SPEED	Speed of collection vehicle at start of section while data was collected
geometry	Geometry information of the polyline tied to a given PFES section. This was converted from the geomtry information of the shapefile loaded into Numetric.
RIDE NORMALIZE	Normalized IRI value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED RIDE NORMALIZE	Normalized IRI value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
RUT NORMALIZE	Normalized rutting value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED RUT NORMALIZE	Normalized rutting value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
FAT CRK NORMALIZE	Normalized fatigue cracking value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED FAT CRK NORMALIZE	Normalized fatigue cracking value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ENV CRK NORMALIZE	Normalized environmental cracking value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED ENV CRK NORMALIZE	Normalized environmental cracking value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
JOINT SPALL NORMALIZE	Normalized concrete joint spalling value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
FAULT NORMALIZE	Normalized concrete joint faulting value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
SLAB CRACK NORMALIZE	Normalized concrete cracked slab value between 0 to 100. 100 being ideal and smooth ride quality and 0 being poorest ride quality
LENGTH FT	Length of the PFES section (ft)
ADJUSTED JOINT SPALL NORMALIZE	Normalized concrete joint spalling value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED FAULT NORMALIZE	Normalized concrete joint faulting value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED SLAB CRACK NORMALIZE	Normalized concrete cracked slab value between 0 to 100 resulting from the RECOMMENDATION. 100 being ideal and smooth ride quality and 0 being poorest ride quality
NOTES	Internal HDOT notes for a given PFES section
OCI VALUE	Average of RIDE NORMALIZE, RUT NORMALIZE, FAT CRK NORMALIZE, and ENV CRK NORMALIZE in the case of Asphalt pavement. Average of JOINT SPALL NORMALIZE, FAULT NORMALIZE, SLAB CRACK NORMALIZE
RUT MAP21	Rutting condition based on Map 21 specifications. Good<0.2 in; Fair is between 0.2 and 0.4 inches; Poor>0.4 inches
IRI MAP21	International Roughness Index condition based on Map 21. Good<95; Fair is between 95 and 170; Poor>170 in/mi
FAULT MAP21	Concrete transverse joint faulting condition based on Map 21 specification. Good<0.1; Fair is between 0.1 and 0.15; Poor>0.15 in
AC CRACKING % MAP21	Percent Cracking on Asphalt pavement following HPMS distresses
PC CRACKING % MAP21	Percent Cracking on Concrete pavement following HPMS distresses
PC Condition Comb MAP21	Combining Ride, Rutting, and AC Cracking percent to determine overall condition
AC Condition Comb MAP21	Combining Ride, Faulting, and PC Cracking percent to determine overall condition
AC Condition Master MAP21	Classifying the overall condition given the pavement type

FIELD	DESCRIPTION
PC Condition Master MAP21	Classifying the overall condition given the pavement type
URBAN CODE	
MAP21 CONDITION	Condition of PFES section following Map 21 guidelines. All components must be considered Good to be a Good section, 2 or more components considered Poor will make a section Poor, and all other combinations are considered Fair
OCI CHANGE	Difference between the Adjusted OCI and the original OCI Value
RAVEL1 DEDUCT	Low severity Raveling deduction value roughly based on PCI raveling deducts
POTHOLE DEDUCT	Pothole deduction value roughly based on PCI medium severity pothole deduct
RAVEL2 DEDUCT	Medium severity Raveling deduction value roughly based on PCI raveling deducts
RAVEL3 DEDUCT	High severity Raveling deduction value roughly based on PCI raveling deducts
JOINT SPALL NORMALIZE CONDITION	Joint spall normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
SLAB CRACK NORMALIZE CONDITION	Slab Crack normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
FAULT NORMALIZE CONDITION	Fault normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
RIDE NORMALIZE CONDITION	Ride normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
RUT NORMALIZE CONDITION	Rut normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
FAT CRK NORMALIZE CONDITION	Fatigue/Alligator normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
ENV CRK NORMAILIZE CONDITION	Environmental cracking normalized condition. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
ADJUSTED OCI VALUE	Change to the OCI given the RECOMMENDATION
ROAD CONDITION	Overall condition of the PFES section using Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR
ADJUSTED ROAD CONDITION DUE TO CONDITION	Overall condition of the PFES section using adjusted values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
ADJUSTED OCI DUE TO TIME	New OCI value following the RECOMMENDATION based on the age of the PFES section
LAST TREATMENT TYPE	Last treatment done to the PFES section based on HDOT records
LAST TREATMENT YEAR	Year of last treatment to the PFES section based on HDOT records
RECOMMENDATION DUE TO TIME	Treatment recommendation based on LAST TREATMENT YEAR
RECOMMENDATION DUE TO CONDITION	Treatment recommendation based on the normalized distress values
TOTAL SURFACE AREA	Sum of all pavement surface types if several are present (sq yd)
Road Condition Number For Sorting	Number tied to ROAD CONDITION to be able to ordeer charts as Good, Fair, and Poor
RECOMMENDATION COST DUE TO CONDITION	Cost of the proposed condition based recommendation using surface area and unit cost of the treatment
RECOMMENDATION COST DUE TO TIME	Cost of the proposed age based recommendation using surface area and unit cost of the treatment
PREPARATION RECOMMENDATION DUE TO CONDITION	Treatment done to pavement before any chip seal or functional repair Recommendation
PREPARATION RECOMMENDATION COST DUE TO CONDITION	Cost of preparation treatment based on area of the section and the quantity of cracking
BENEFIT SUBTOTAL	AADT Benefit factor multiplied by the change in OCI based on the recommendation based on condition



FIELD	DESCRIPTION
TREATMENT TYPE	All recommendations are grouped into the general catigories of Presurvation, Minor Rehab, and Major Rehab. Crack seals, chip seals, and functional repair are considered Preservation; minor and major rehabilitations are self titled from respective recommendations. This field looks at recommendations based on current road condition data.
TREATMENT TYPE DUE TO TIME	All recommendations are grouped into the general catigories of Presurvation, Minor Rehab, and Major Rehab. Crack seals, chip seals, and functional repair are considered Preservation; minor and major rehabilitations are self titled from respective recommendations. This field looks at recommendations based on age of the section.
BENEFIT/COST DUE TO CONDITION	Ratio value of the Benefit subtotal devided by the total cost to perform the recommendation based on the current pavement condition data
BENEFIT/COST DUE TO TIME	Ratio value of the Benefit subtotal devided by the total cost to perform the recommendation based on the known age of the pavement.
Photolog	Link for Roadview explorer
PREPARATION RECOMMENDATION DUE TO TIME	Treatment done to pavement before any chip seal or functional repair Recommendation
PREPARATION RECOMMENDATION COST DUE TO TIME	Cost of preparation treatment based on area of the section and the quantity of cracking
TOTAL COST DUE TO CONDITION	Cost of both the given RECOMMENDATION and cost of PREPERATION based on condition data of the section
TOTAL COST DUE TO TIME	Cost of both the given RECOMMENDATION and cost of PREPERATION based on age of the section
IRI Map 21 Sorting	Number tied to IRI MAP21 to be able to order charts as Good, Fair, and Poor
MAX_AADT_TRUCKS	Sum of both the maximum single unit truck count and maximum combo truck
EDGECRKS1	Low severity edge cracking length (ft)
EDGECRKS2	Median severity edge cracking length (ft)
EDGECRKS3	High severity edge cracking length (ft)
SHOVING	Area of high severity Shoving (sq ft)
TRANLTHS1	Length of low severity transverse cracks (ft)
TRANLTHS2	Length of medium severity transverse cracks (ft)
TRANLTHS3	Length of high severity transverse cracks (ft)
BLEEDING	Area of bleeding (sq ft)
RAVELING	Area of raveling (sq ft)
REFLECS1	Low severity reflection cracking length (ft)
REFLECS2	Medium severity reflection cracking length (ft)
REFLECS3	High severity reflection cracking length (ft)
PHSM	Small pothole count. Ony classified for 2019 data and newer.
PHMD	Medium pothole count. Ony classified for 2019 data and newer.
PHLG	Large pothole count. Ony classified for 2019 data and newer.
PCPATCTS1	Count of low severity pacthing
PCPATCTS2	Count of medium severity pacthing
PCPATCTS3	Count of high severity pacthing
SEALCRKTOT	Total length of sealed cracking (ft)
DIVSLABS1	Count of low severity divided slab
DIVSLABS2	Count of medium severity divided slab
DIVSLABS3	Count of high severity divided slab
BUCKLS1	Count of affected slabs with Buckling or blowups of low severity

FIELD	DESCRIPTION
BUCKLS2	Count of affected slabs with Buckling or blowups of median severity
BUCKLS3	Count of affected slabs with Buckling or blowups of high severity
POPOUTS	Count of affected slabs with popouts
MAPCRKARS1	Count of slabs with Map Cracking of Low Severity
MAPCRKARS2	Count of slabs with Map Cracking of Medium Severity
MAPCRKARS3	Count of slabs with Map Cracking of High Severity
AADT_TRUCK_BENEFIT_FACTOR	Benefit factor that changes based on the level of AADT and Truck present. Ranges from 0.4 to 0.43. See Truck Traffic Factor table for ranges.
OCI_VALUE_PROP1	Overall condition index proposition 1. Weighted ride with 0.3, Fatigue cracking with 0.3, environmental cracking with 0.25, rutting weighted with 0.15, Joint spall weighting of 0.25, Slab cracking weighing of 0.3, and faulting weighting of 0.15
OCI_PROP1_CONDITION	Overall condition of the PFES section using the normalized values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 1 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
ADJUSTED_OCI_VALUE_PROP1	Recalculated OCI value using proposition 1 weighting given the Recommendation 2 logic
OCI_CHANGE_PROP1	Difference between the Adjusted OCI Value for Proposition 1 and the original OCI Value
ADJUSTED_OCI_CONDITION_PROP1	Overall condition of the PFES section using adjusted values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 1 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
OCI_VALUE_PROP2	Overall condition index proposition 1. Weighted ride with 0.2, Fatigue cracking with 0.45, environmental cracking with 0.25, rutting weighted with 0.1, Joint spall weighting of 0.25, Slab cracking weighing of 0.45, and faulting weighting of 0.1
OCI_PROP2_CONDITION	Overall condition of the PFES section using the normalized values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 2 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
ADJUSTED_OCI_VALUE_PROP2	Recalculated OCI value using proposition 2 weighting given the Recommendation 2 logic
OCI_CHANGE_PROP2	Difference between the Adjusted OCI Value for Proposition 2 and the original OCI Value
ADJUSTED_OCI_CONDITION_PROP2	Overall condition of the PFES section using adjusted values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 2 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
OCI_VALUE_PROP3	Overall condition index proposition 1. Weighted ride with 0.3, Fatigue cracking with 0.3, environmental cracking with 0.25, rutting weighted with 0.15, Joint spall weighting of 0.25, Slab cracking weighing of 0.3, and faulting weighting of 0.15
OCI_PROP3_CONDITION	Overall condition of the PFES section using the normalized values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 2 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
ADJUSTED_OCI_VALUE_PROP3	Recalculated OCI value using proposition 3 weighting given the Recommendation 2 logic
OCI_CHANGE_PROP3	Difference between the Adjusted OCI Value for Proposition 3 and the original OCI Value
ADJUSTED_OCI_CONDITION_PROP3	Overall condition of the PFES section using adjusted values of Ride, Rut, Alligator, and Environmental Cracking for asphalt; Ride, Faulting, Slab cracking, and Joint cracking for concrete surfaces using the proposition 3 weighting. Greater than 80 is considered GOOD, between 60 and 80 is FAIR, and less than 60 is POOR.
PAVE_REPAIR_FATIGUE	Pavement repair percentage based on the value weighting 2/3 of the fatigue cracking normalization value and 1/3 of the environmental normalization value. See Pavement repair table above in section 3.2
RECOMMENDATION_2	Recommendation for a given section based on logic for PFES 2.0
WET_DRY	If the majority of a section falls within a region reporting less than 50 inches of annual rainfall that section is considered dry otherwise it is considered wet. Wet and Dry classification was assigned based on source data from http://rainfall.geography.hawaii.edu/interactivemap.html
NHS	Indicates if the section is on the National Highway System (NHS)
Benefit_Sub_Prop1	AADT Benefit factor multiplied by the change in OCI using poposition 1 weighting based on the PFES 2.0 recommendation
Benefit_Sub_Prop2	AADT Benefit factor multiplied by the change in OCI using poposition 2 weighting based on the PFES 2.0 recommendation
Benefit_Sub_Prop3	AADT Benefit factor multiplied by the change in OCI using poposition 3 weighting based on the PFES 2.0 recommendation



FIELD	DESCRIPTION
Benefit/Cost__Prop1	Ratio value of the Benefit subtotal using OCI Proposition 1 weighting divided by the total cost to perform the recommendation based on the current pavement condition data
Benefit/Cost__Prop2	Ratio value of the Benefit subtotal using OCI Proposition 2 weighting divided by the total cost to perform the recommendation based on the current pavement condition data
Benefit/Cost__Prop3	Ratio value of the Benefit subtotal using OCI Proposition 3 weighting divided by the total cost to perform the recommendation based on the current pavement condition data
TRUCK_BENEFIT_SUB	AADT Truck Benefit factor multiplied by the change in OCI based on the PFES 2.0 recommendation
TRUCK_BENEFIT/COST	Ratio value of the Benefit subtotal using the Truck Benefit Subtotal divided by the total cost to perform the recommendation based on the current pavement condition data
TRAFFIC_RECOMMENDATION_1	Recommendation for a given section based on traffic volumes specified for proposal 1 in Pavement Treatments and Truck Traffic table
TRAFFIC_RECOMMENDATION_2	Recommendation for a given section based on traffic volumes specified for proposal 2 in Pavement Treatments and Truck Traffic table
SOIL_WEIGHTING_BENEFIT/COST	Benefit / cost ratio applying weighting factors driven by the age of the islands. Older islands like Kawai have a slightly higher benefit weighting. See BEARING CAPACITY OF UNDERLYING SOILS table for more detail
ADJUSTED_RIDE_NORMALIZATION_2	Normalized IRI value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_RUT_NORMALIZATION_2	Normalized rutting value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_ENV_CRK_NORMALIZATION_2	Normalized environmental cracking value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_FAT_CRK_NORMALIZATION_2	Normalized fatigue cracking value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_FAULT_NORMALIZATION_2	Normalized concrete joint faulting value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_JOINT_SPALL_NORMALIZATION_2	Normalized concrete joint spalling value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
ADJUSTED_SLAB_CRACK_NORMALIZATION_2	Normalized concrete cracked slab value between 0 to 100 resulting from the RECOMMENDATION 2. 100 being ideal and smooth ride quality and 0 being poorest ride quality
PRIORITY	3 priority levels driven by traffic volume and if the section is on the National Highway System
ADJUSTED_OCI_VALUE_2	Recalculated OCI Value if the Recommendation 2 treatment is performed
TREATMENT TYPE 2	All recommendations from the RECOMMENDATION 2 field are grouped into the general catigories of Presurvation, Minor Rehab, and Major Rehab. Crack seals, chip seals, and functional repair are considered Preservation; minor and major rehabilitations are self titled from respective recommendations. This field looks at recommendations based on current road condition data.
RECOMMENDATION 2 COST	Cost of the proposed recommendation using PFES 2.0 logic using surface area and unit cost of the treatment
BENEFIT SUBTOTAL 2	AADT Benefit factor multiplied by the change in OCI using equal weighting based on the PFES 2.0 recommendation
BENEFIT/COST 2	Ratio value of the Benefit subtotal using OCI Proposition 1 weighting divided by the total cost to perform the recommendation based on the current pavement condition data