+ integrity + technology + innovation + initiative + knowledge + creativity

Parking Capital Improvement Program Plan (CIPP) Summary

University of Hawai‘i at Mānoa
Honolulu, HI

sp+ UNIVERSITY SERVICES

Submitted to:

Cathleen Matsushima
Manager • Commuter and Fleet Services

UNIVERSITY of HAWAI‘I® MĀNOA

June 22, 2018

As authorized by SP+ (Contract No. 2016-05108) on behalf of University of Hawaii - Manoa, **Kimley-Horn** is in the process of completing a limited condition assessment of the three parking garages and over one and a half million square feet of pavement in eighty-four parking lots in accordance with the authorized scope of work. Campus parking inventory include 5,800± parking spaces. The three parking garages provide for approximately 50% of this campus inventory.

The purpose of this assessment was to observe and document the general condition of these parking facilities, identify deficient items, and provide recommendations for a Capital Improvement and Protection Program (CIPP) to prolong the life spans of these parking facilities and recommend a program to properly care for these substantial assets. **Kimley-Horn** performed a limited condition assessment from June 20-30, 2017, of the garages' and lots' readily accessible and visible elements. Enclosed areas or otherwise inaccessible spaces were not observed. Structural analysis, gravity or lateral, of the existing structures, code review, or accessibility assessments were not included in the scope of work.

Garages

Our assessment of the garage structures included the following:

- Reviewing available parking garage construction documents and previous assessment reports and repair documents.
- Conducting a walk-through visual assessment of garages and lots to note and document current conditions.
- Performing limited concrete soundings within selected areas of garages.
- Photographic documentation of representative conditions.
- Recording field notes.
- Review of Wiss, Janney, Elstner Associates, Inc. February 19, 2018 report for material testing of 30 concrete core samples extracted from the 5th, 4th and 3rd levels of the Phase I Garage.

The elements observed during the condition assessment of garages are grouped into five categories:

- Structural – The observed structural elements included the slabs, beams, columns, walls, façade connections, masonry, and parapets.
- Waterproofing – The observed waterproofing systems generally consisted of expansion joints, joint sealants, traffic coating, and architectural sealants.

- Systems – The systems observed included lighting, piping, fire protection, and electrical.
- Operational – The operational systems generally included striping, signage, sidewalks / curbs / medians, stair / elevator cores, railing, safety items, CCTV, pipe protection, vehicle barriers, and any parking and revenue control equipment.
- Aesthetic – The observed aesthetic elements consisted of the exterior façade, painting, landscaping, and general overall appearance.

In general, the condition assessment identified conditions common among parking structures of similar age and construction type in this region. **The overall condition of the Phase I Garage is judged to be Fair- to-Good, the condition of the Phase II Garage is judged to be Good**, **and the condition of the Dole Parking Garage is judged to be Very Good.**

It was previously reported and noted during our visual survey that the existing pedestrian/vehicle barrier metal guardrails in the Phase I and Phase II Garages are not rated for vehicle bumper impact loading. In addition, they have experienced varying levels of bumper impact damage and/or corrosion related deterioration of railing posts. These conditions are considered a life-safety structural and operational issue and it is recommended that the University prioritize the repair/retrofit or replacement of these metal guardrails as soon as logistically possible.

Given the age of the Phase I Garage and its overall condition, level of concrete deterioration and contamination and life-safety structural and operational issue associated with the pedestrian/vehicle barrier metal guardrails, we recommend that every 1 to 2 years the University have a qualified parking structure restoration engineer perform structural condition assessment of this garage to more closely gauge the structure's rate of deterioration, be alert to potentially serious problems, and prepare updates to CIPP program priorities and budgets for needed repairs and maintenance.

Phase I Garage Material Testing

The University contracted with Wiss, Janney, Elstner Associates, Inc. (WJE) to perform material testing of 30 core samples extracted from the 5th, 4th and 3rd levels of the Phase I Garage. Locations for core sample removal and development of material testing program was done in collaboration with Kimley-

Horn. Core samples were extracted during the week of December 18, 2017. Laboratory testing of core samples was conducted to determine depth of concrete carbonation, chloride content and petrographic examination was performed to assess the general material properties and identify distress, if any, in the concrete samples. Depth of concrete carbonation test were performed on 21 core samples, test to determine chloride content was performed on 25 core samples at depths of ¼"- ¾", ¾"-1 ¼" and 1 ¼"- 1 ¾". Petrographic examinations were performed on 2 core samples. Data from this testing program was used to correlate noted corrosion related concrete deterioration, assess the potential for future concrete deterioration, and inform the development of the Phase I Garage recommended CIPP.

Test data indicates that the upper portions of concrete that have undergone carbonation and chloride contamination have reached the ACI 222R-01 recommended threshold limit of chloride contamination necessary for imitating corrosion of 0.08% water soluble chloride by wt. of cement and 0.1% acid soluble chloride by wt. of cement. The average depth of concrete carbonation and chloride contamination is near the depth of reinforcement for concrete beams and posts along the edges of the garage perimeter and interior atrium.

Rate of carbonation of concrete is higher in high humidity environments such as Hawaii. According to ACI 222, under constant conditions, an ambient relative humidity of 60% has been the most favorable for carbonation. Average annual humidity in Honolulu is reported to be 68%. Carbonation of concrete reduces concrete's alkalinity, thereby permitting corrosion of embedded steel. The decrease in pH of the carbonated concrete also increases the risk of corrosion because the concentration of chlorides necessary to initiate corrosion is directly related to pH (i.e. carbonation). Therefore, given the presence of concrete carbonation, chloride contamination, and the environmental conditions of Hawaii, carbonation of concrete and chloride contamination is expected to continue, resulting in corrosion-related concrete deterioration. Preventive concrete repair and maintenance is recommended to mitigate and reduce the rate of continued concrete deterioration.

Summarized in Table 1 is our opinion of probable costs associated with the recommended immediate term (Year 1), the intermediate term (Year 2-5), and the long term (Year 6-10) CIPP for each garage. Table 2 presents a listing of the main critical CIPP elements for each garage.

Table 1: Opinion of Probable CIPP Program Cost Totals

	Year Built	No. of Stalls	Area (SF)	Immediate Year 1	Intermediate Year 2–5	Long-Term Year 6–10	Total
Total Costs							
Phase I Garage (Zone 20)	1974-75	1,727	737,050	$38,402,000	$22,257,000	$7,661,000	$68,320,000
Phase II Garage (Zone 20)	1996-97	900	339,936	$13,273,000	$10,867,000	$1,550,000	$25,690,000
Dole Garage (Zone 22)	2003-04	276	94,340	$181,000	$2,699,000	$182,000	$3,062,000

Total	Immediate	Intermediate	Long-Term	Total
	$51,856,000	$35,823,000	$9,393,000	$97,072,000

Table 2: Summary of Key Elements of Recommended Parking Garages CIPP

	Year Built	No. of Stalls	Area (SF)	Immediate Year 1		Intermediate Year 2-5	
				CIPP Items	Associated Costs	CIPP Items	Associated Costs
Phase I Garage (Zone 20)	1974-75	1,727	737,050	Retrofit/replace metal guardrail serving as vehicle barrier system	$16,977,000	Remove top level architectural topping slab within parking areas	$6,021,000
				Repair/replace metal guardrail serving as pedestrian guardrail system	$20,001,000	Install traffic coating on top level structural topping slab, replace expansion joint provide supplemental floor drains	$11,987,000
				Repair vertical and overhead concrete spalls	$224,000		
				Repair fire safety system	$1,197,000	Apply silane sealer on covered levels	$2,081,000
Phase II Garage (Zone 20)	1996-97	900	339,936	Retrofit/replace perimeter metal guardrail serving as a vehicle barrier system	$9,770,000	Remove/replace traffic coating on top level	$6,024,000
				Retrofit/replace perimeter metal guardrail serving as pedestrian guardrail barrier system	$2,882,000	Replace expansion joints on all levels	$2,050,000
				Repair fire safety system	$505,000	Install supplemental floor drains on top level	$373,000
						Repair floor, vertical and overhead concrete spalls	$298,000
Dole Garage (Zone 22)	2003-04	276	94,340	Power wash interior/façade surfaces	$136,000	Remove/replace traffic coating on top level	$1,968,000
				Flush and clean floor drains	$34,000	Repair spalls, delaminations and exposed reinforcement and epoxy inject cracks	$294,000

The above opinions of cost are based on limited field observations and quantifications. Unit price information is based on our current knowledge of the market conditions, RS Means, and historical repair cost information adjusted for the Honolulu market. No solicitation or information from contractors was gathered. Cosmetic, decorative, tenant improvements, enhancements,

improvements required for warranty transfer, and/or routine or normal preventive maintenance items are not included in the opinion of probable cost. This opinion of probable construction cost is presented to assist the University to develop a general order- of-magnitude cost for budgetary planning purposes.

Remaining Useful Service Life of Parking Structures

The age, construction type, current structure condition and geographic location of a parking garage influence prediction of remaining useful service life. Useful service life of concrete parking garages constructed and routinely maintained in accordance with industry standards is about 50 years. In milder climates such as in Honolulu, this service life can be as long as 70± years. Generally, end of service life of building structures is defined as follows:

- Structural safety is unacceptable due to material degradation or exceeding the design load-carrying capacity;
- Maintenance requirements exceed available resource limits;
- Aesthetics become unacceptable; or
- Functional capacity of the structure is no longer sufficient for a demand.

Phase I Parking Garage was constructed circa 1974-75 and as such it has provided approximately 43 years of service. Given the current condition of the concrete structure, it is our opinion that with implementation of the recommended repair program and regular routine and preventative maintenance approximately 15 to 20 years of additional service life can be achieved.

In addition, given the age of the Phase I Garage and its overall condition, level of concrete deterioration and contamination and pedestrian/vehicle barrier metal guardrails life-safety structural and operational issues, we recommend that every 1 to 2 years the University have a qualified parking structure restoration engineer perform structural condition assessment of this garage to more closely gauge the structure's rate of deterioration, be alert to potentially serious problems, and prepare updates to CIPP program priorities and budgets for needed repairs and maintenance.

Phase II Parking Garage was constructed circa 1996-97 and as such it has provided approximately 21 years of service. Given the current condition of the concrete structure, it is our opinion that with implementation of the recommended repair program and regular routine and preventative

maintenance approximately 30 to 40 years of additional service life can be achieved.

The Dole Parking Garage was constructed circa 2003-04 and as such it has provided approximately 14 years of service. Given the current condition of the concrete structure, it is our opinion that with implementation of the recommended repair program and regular routine and preventative maintenance approximately 50+ years of additional service life can be achieved

The above opinions of remaining service life do not consider the University's available resources, aesthetic criteria, structure functionality and parking demand and the campus's future growth and development plans.

Parking Lot Pavement Assessments

The purpose of this assessment was to observe and document the general condition of these parking areas, identify pavement deficiencies, and provide repair recommendations for a Capital Improvement and Protection Program (CIPP) to prolong the service life of these parking lot pavements in a cost-effective manner.

During the assessment, all designated surface parking areas were reviewed in the field and the following information was collected using an ArcGIS data collection program and the "PASER" pavement surface rating system.

- Each parking area was evaluated using the PASER rating system and assigned a Pavement Condition Index (PCI) between 0-100 on the modified PASER scale.
- Each parking area was subdivided if there was a change in pavement type or a greater than twenty- point change in the PCI
- Major pavement distresses were categorized by type, severity, and extent
- Multiple photographs for each distress were tagged geographically
- ADA areas were located and observed for general compliance
- Recommended repair strategies were advised within each area with probable costs for each corresponding zone and sub section

The overall weighted Pavement Condition Index (PCI) per the PASER rating system for all parking areas on campus was observed to be **"Fair" with a PCI rating of 47 on the 100-point scale**.

The parking area pavement is at the critical point, such that delaying repairs beyond this critical point will begin to see a sharp increase in repair costs as pavements below the critical point will require more substantial and expensive repairs. This typical pavement deterioration curve is shown below and is a visual representation of what the critical point means. Factors including but not limited to original section design, quality of original construction, subgrade condition, traffic loadings, climate, and the quality and extent of the maintenance program in place all help to shape a pavement deterioration curve.

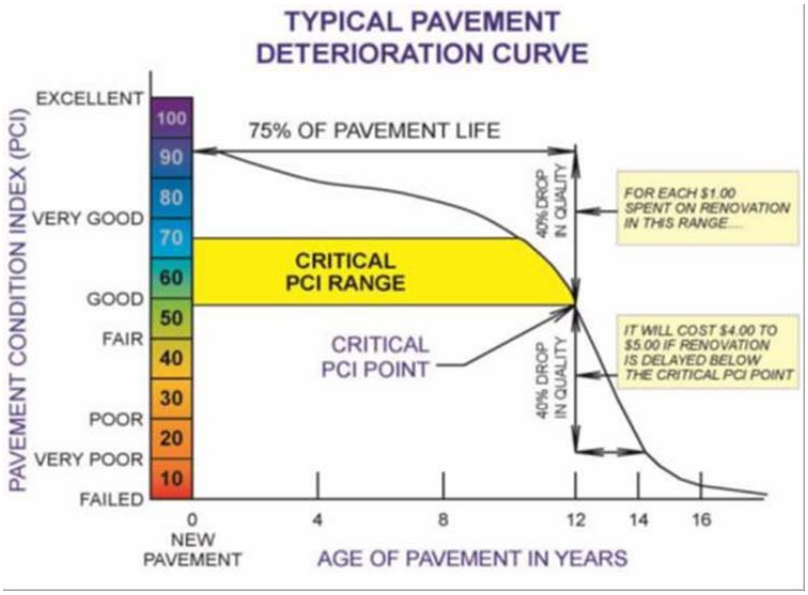


Figure E-1

The overall condition of pavements on campus lots is shown visually in the graph in Figure E-2, which divides the pavement into condition ratings and shows the magnitude of pavement area rated in each condition. The bar graph depicts the condition trend observed across the campus with nearly 65% of the pavement is at or beyond the critical range and these areas require attention. Observed conditions of all parking lots is depicted in the attached aerial sheets at the end of this document.

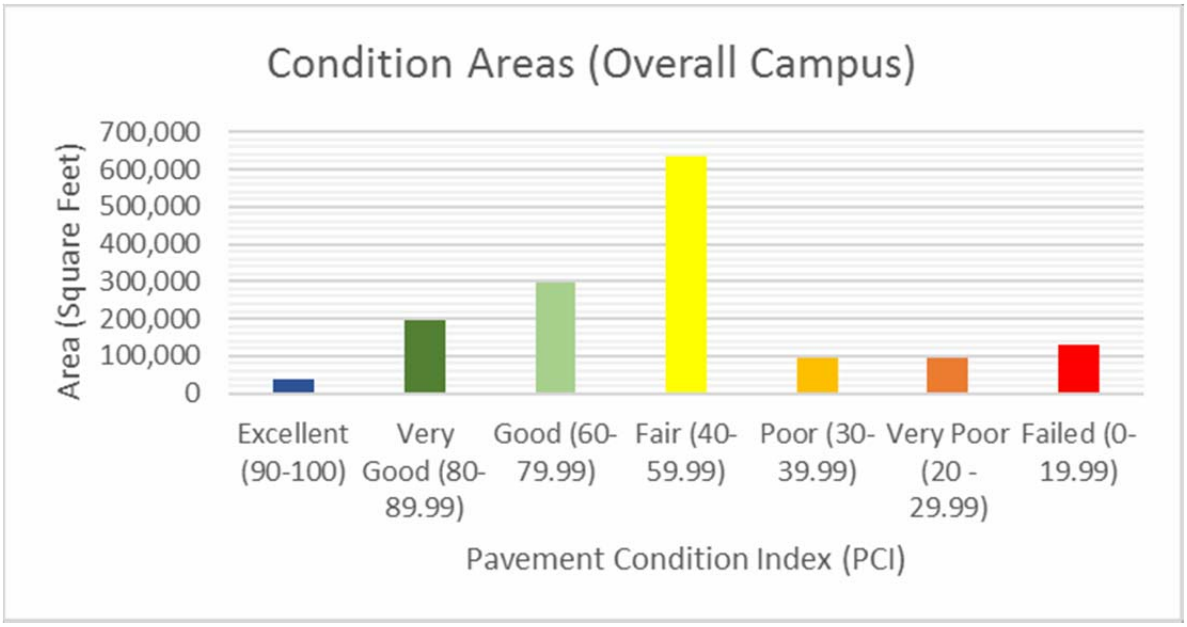


Figure E-2

Recommendations

Based on the observations made in the field, a heavy focus should be placed on preventative maintenance to extend the service life of the pavements that are in the critical range. These preventative repairs should be supplemented by a combination of rehabilitation and reconstruction to most cost effectively repair the lots.

The repair recommendations summarized in Table 3 below were broken into three time frames. The Immediate Term (Year 1) repairs address many safety concerns and priority areas mentioned by University personnel. The Intermediate Term (Year 2-5) repairs focus on preventative maintenance while rehabilitating areas in the lower PCI range before they reach the need for reconstruction. The Long Term (Year 6-10) repairs were recommended based on predicted repair areas and their associated unit costs.

We would recommend doing a follow up evaluation at the beginning of the Long Term to update completed repairs and reassess the rate of deterioration that is occurring. The Immediate Term (Year 1) repairs are color coded by zone to depict the main repair strategy that is occurring in that zone. Table 4 provides a general summary of what each maintenance strategy may entail. Repair

recommendations were made without pavement thickness or soil information obtained by pavement cores. The information obtained from pavement cores would help to choose the most ideal repair type in areas thought to be rehabilitation or reconstruction

Table 3: Opinion of Probable Parking Lots Pavement CIPP Program Cost Summary

	Condition Assessment Repair Items			
	Immediate Term	Intermediate Term	Long Term	
	Year 1	Year 2-5	Year 6-10	Total
Zone				
1	$ 229,000.00	$ 62,000.00	$ 154,000.00	$ 445,000.00
2	$ 55,000.00	$ 11,000.00	$ 309,000.00	$ 375,000.00
3	$ 347,000.00	$ 160,000.00	$ 892,000.00	$ 1,399,000.00
4	$ 158,000.00	$ 260,000.00	$ 864,000.00	$ 1,282,000.00
5	$ 200,000.00	$ 212,000.00	$ 574,000.00	$ 986,000.00
7	$ -	$ 17,000.00	$ 113,000.00	$ 130,000.00
8	$ 89,000.00	$ 108,000.00	$ 225,000.00	$ 422,000.00
9	$ 70,000.00	$ 183,000.00	$ 328,000.00	$ 581,000.00
12	$ -	$ 43,000.00	$ 249,000.00	$ 292,000.00
13	$ 355,000.00	$ 216,000.00	$ 898,000.00	$ 1,469,000.00
17	$ 49,000.00	$ 194,000.00	$ 454,000.00	$ 697,000.00
18	$ -	$ 87,000.00	$ 227,000.00	$ 314,000.00
19	$ -	$ 17,000.00	$ 67,000.00	$ 84,000.00
20	$ -	$ 4,000.00	$ 9,000.00	$ 13,000.00
21	$ -	$ 101,000.00	$ 141,000.00	$ 242,000.00
22	$ -	$ 16,000.00	$ 118,000.00	$ 134,000.00
23	$ -	$ 19,000.00	$ 14,000.00	$ 33,000.00
25	$ 47,000.00	$ 110,000.00	$ 323,000.00	$ 480,000.00
Unreported	$ 9,000.00	$ 201,000.00	$ 995,000.00	$ 1,205,000.00
Other	$ -	$ 77,000.00	$ -	$ 77,000.00
	Immediate Term	Intermediate Term	Long Term	Total
Total	$ 1,608,000.00	$ 2,021,000.00	$ 6,954,000.00	$ 10,583,000.00
Total + Contingency	$ 1,849,200.00	$ 2,324,150.00	$ 7,997,100.00	$ 12,170,450.00

Costs were based primarily from unit price information obtained from multiple local contractors relative to anticipated repair scenarios. Although we provided very limited information about the project we did provide consistent work scopes with varying quantities.

These opinions of probable costs were completed without the benefit of pavement cores. Pavement core data is important in establishing pavement thicknesses, base and subgrade properties and for long term projections of future repair strategies. Pavement cores are recommended for repair areas called out in the immediate term plan.

There is a large difference in unit pricing based on material quantity that could make a substantial difference in the repair costs. Recognizing that it may not be realistic to close multiple parking areas at once, the opinion of probable cost provided utilizes the lower quantity pricing which has higher costs, but by grouping multiple repair areas and increasing the quantity that is bid, a better unit price can be obtained. The phasing of the project is recognized to be an important factor since there is already a limited number of parking spaces. It is recommended that continuous work including night work is be utilized to minimize loss of parking and associated revenue. An additional way to help get better improve pricing is to have a competitive bidding process. This includes utilizing multiple bidders and having detailed design documents including design plans, project specifications, a pre-bid meeting and bid forms that will provide the contractors with specific project information while ensuring that the University will have better control over the project implementation and quality control.

Table 4: Overview of PCI Pavement Maintenance Strategy

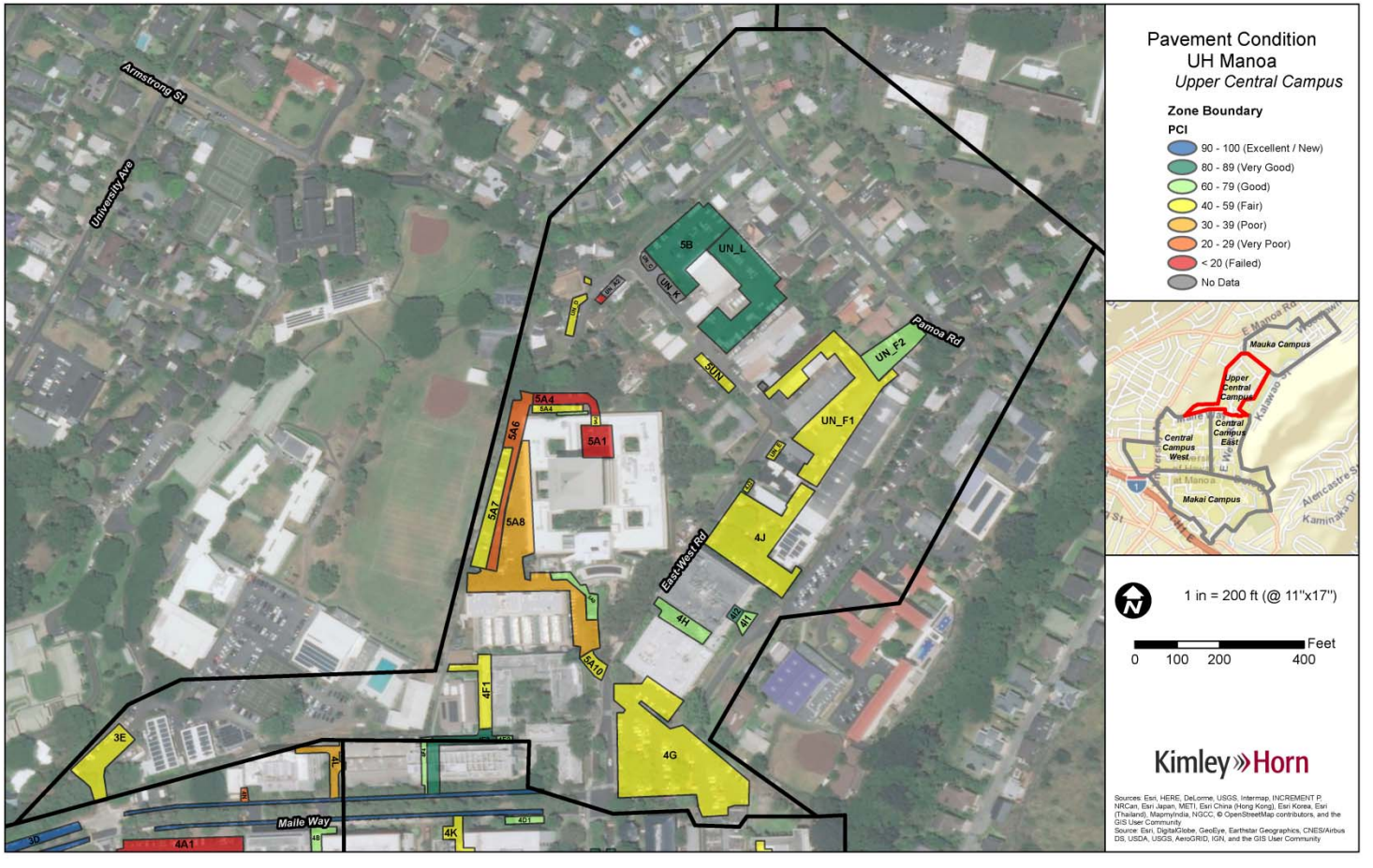
PCI	Budget Type	Asphalt Typical Repairs	Concrete Typical Repairs
90 - 100 (Excellent / New)	No action required		
80 - 89 (Very Good)	Little or no maintenace	Crack sealing	Crack sealing
60 - 79 (Good)	Prevenative maintenace	Crack sealing (some cracks may require routing)	Crack sealing
40 - 59 (Fair)	General Rehabiliation	Crack sealing (requires routing) Crack repairs (partial-depth milling and patching) Cut and patch (up to 10% of area) Surface seal (seal coat or slurry seal) Re-stripe	Crack sealing and joint cleaning/sealing
30 - 39 (Poor)	General Rehabiliation	Partial-depth mill and replace entire area Proof-roll and perform incremental milling and replacement or full depth repairs where required Repair isolated distress areas and overlay entire segment depending on existing site conditions Re-stripe	Full depth joint repair Chipping and patching spalled joints Removal of isolated slabs Asphalt overlay
20 - 29 (Very Poor)	General Rehabiliation	Remove existing asphalt with full-depth milling or pulverization 20% base repair with undercutting to strengthen sub-grade Addition of sub-base as needed Install replacement asphalt section Re-stripe	Subgrade undercutting and backfill Joint and slab preparation Full surface overlay
< 20 (Failed)	Reconstruction	Full-depth asphalt and base reconstruction required Re-stripe	Full-depth concrete and base reconstruction required
No Data	None		

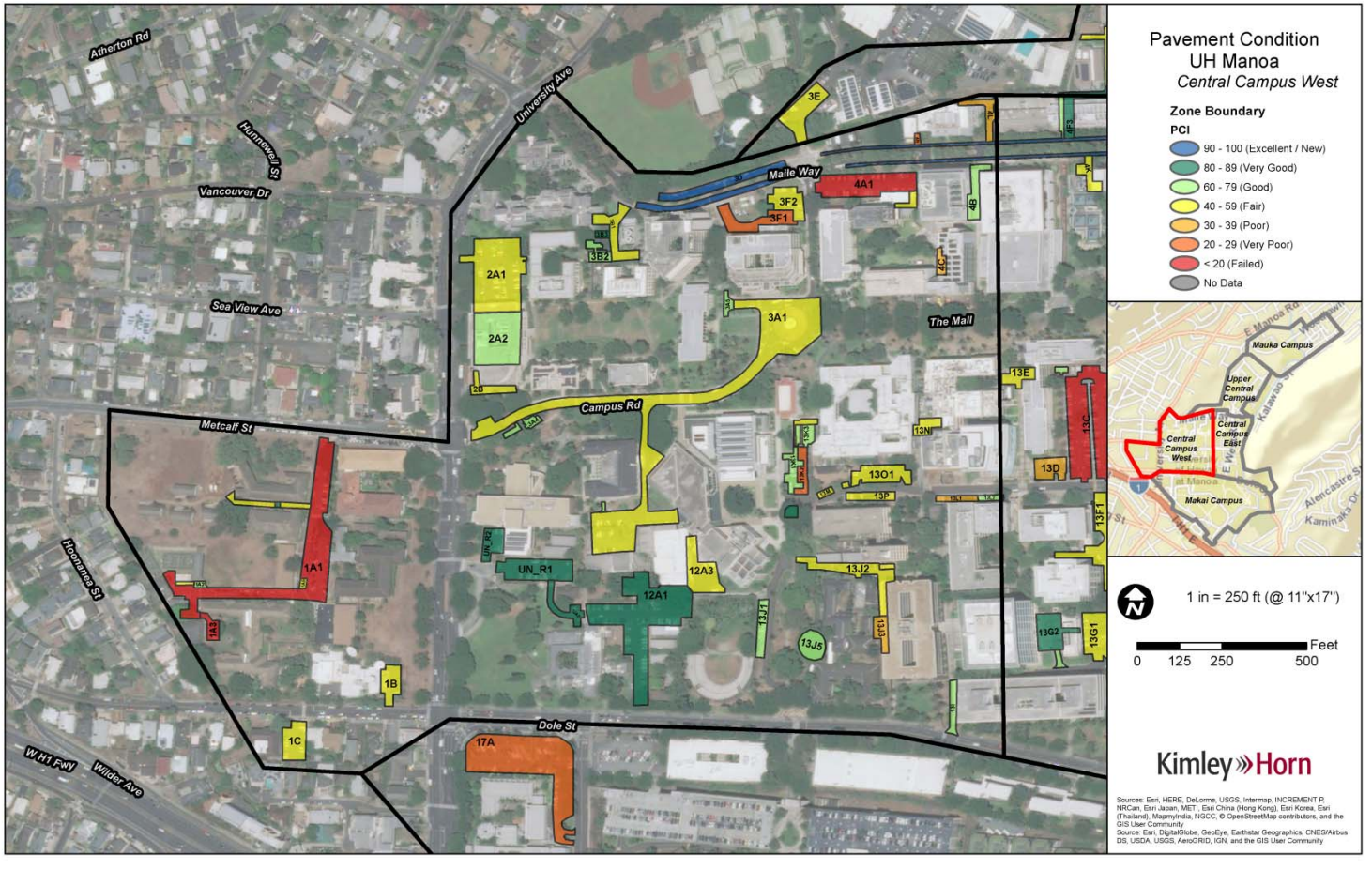
The CIPP serves as a management tool to budget for the repairs, maintenance, and protection of the University's parking facilities continuously over a 10-year period. The repair planning and programming is spread over ten years in an attempt to meet budget constraints, minimum levels of occupancy, revenue loss, and adverse impacts on the parking facility operations. The repair and maintenance needs for the individual, as well as the entire group of facilities, are prioritized and sequenced to optimize the overall capital expenditure. The CIPP provides parking facilities' maintenance and repair recommendation for the immediate term (Year 1), the intermediate term (Year 2-5), and the long term (Year 6-10). The information provided in tables that follow shows the overall summary of the Opinion of Probable Construction Cost for each facility, and is intended to provide the University with the information and recommendations for budget and funding source planning.

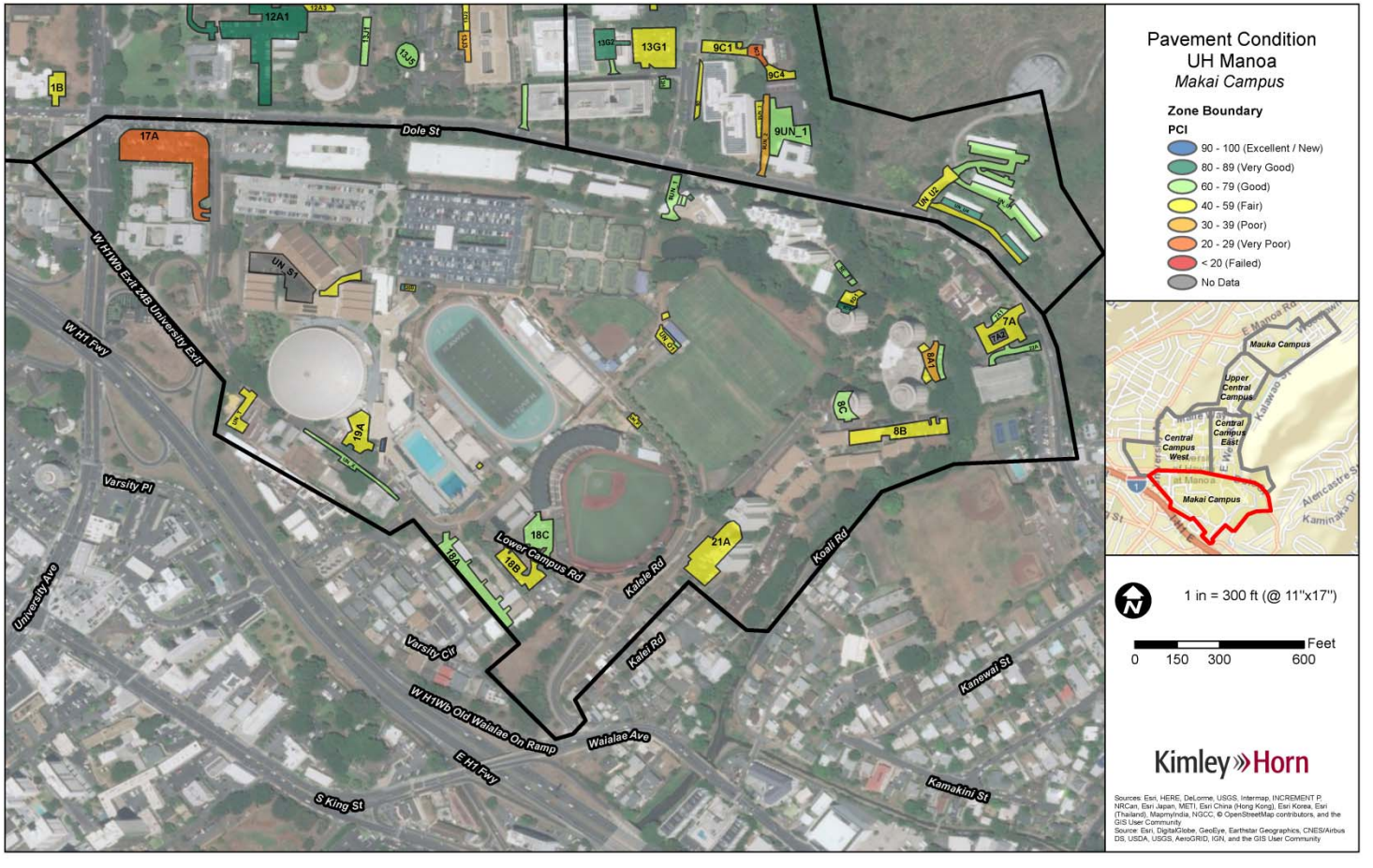
Budget Impact Summary Table

Recommendation	*Cost Estimate Year 1*
CIPP (Parking Structures)	$51,856,000
CIPP (Parking Lots)	$1,849,200
TOTAL	$53,705,200

Appendix A – Capital Improvement Program Plan Graphics


Armstrong St
University Ave
Pamoa Rd
East West Rd
Maile Way
5B
UN_L
UN_K
UN_F2
UN_F1
5UN
5A4
5A6
5A1
5A7
5A8
5A10
4J
4H
4I1
4F1
4G
3E
3D
4A1
4K
Pavement Condition
UH Manoa
Upper Central Campus
Zone Boundary
PCI
90 - 100 (Excellent / New)
80 - 89 (Very Good)
60 - 79 (Good)
40 - 59 (Fair)
30 - 39 (Poor)
20 - 29 (Very Poor)
< 20 (Failed)
No Data
Mauka Campus
Upper Central Campus
Central Campus East
Central Campus West
Makai Campus
1 in = 200 ft (@ 11"x17")
Feet
0
100
200
400
Kimley»Horn
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), Mapmyindia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Pavement Condition
UH Manoa
Central Campus West
Zone Boundary
PCI
90 - 100 (Excellent / New)
80 - 89 (Very Good)
60 - 79 (Good)
40 - 59 (Fair)
30 - 39 (Poor)
20 - 29 (Very Poor)
< 20 (Failed)
No Data
Atherton Rd
Hunnewell St
Vancouver Dr
University Ave
Maile Way
Sea View Ave
Campus Rd
The Mall
Metcalf St
Hoomanes St
Dole St
W H1 Fwy
Wilder Ave
2A1
2A2
3A1
3E
3F2
3F1
4A1
1A1
1B
1C
UN_R1
12A1
12A3
13J2
13J5
13O1
13P
13D
13C
13E
13F1
13G1
13G2
17A
Mauka Campus
Upper Central Campus
Central Campus East
Central Campus West
Makai Campus
1 in = 250 ft (@ 11"x17")
Feet
0 125 250 500
Kimley»Horn


Pavement Condition
UH Manoa
Makai Campus
Zone Boundary
PCI
90 - 100 (Excellent / New)
80 - 89 (Very Good)
60 - 79 (Good)
40 - 59 (Fair)
30 - 39 (Poor)
20 - 29 (Very Poor)
< 20 (Failed)
No Data
Mauka Campus
Upper Central Campus
Central Campus East
Central Campus West
Makai Campus
1 in = 300 ft (@ 11"x17")
Feet
0 150 300 600
Kimley»Horn
Dole St
W H1Wb Exit 24B University Exit
W H1 Fwy
Varsity Pl
University Ave
Varsity Cir
W H1Wb Old Waialae On Ramp
E H1 Fwy
S King St
Waialae Ave
Kalele Rd
Kelei Rd
Lower Campus Rd
Koali Rd
Kanewai St
Kamakini St
12A1
1B
17A
13G1
9C1
9C4
9UN_1
UN_S1
UN_G1
7A
8A1
8B
8C
19A
18C
18B
18A
21A

+ integrity + technology + innovation + initiative + knowledge + creativity




SP+ PARKING

Brett Munkel, CAPP
1510 Shade Tree Way
Alpharetta, GA 30009
770.845.6180