Final Preservation Plan for County of Maui Bridges Within the Hāna Highway Historic District

Prepared For:

County of Maui
Department of Public Works and Waste Management

Prepared By:

Wilson Okamoto & Associates, Inc.

December 2001

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GLOSSARY OF TERMS AND ACRONYMS

AASHTO – American Association of State Highway and Transportation Officials

Abutment – the walls on either side of the stream supporting the ends of the bridge deck.

AHEM – Alliance for the Heritage of East Maui

Balustrade or open-balustrade – A decorative bridge railing design with posts supporting a top railing. The space between the posts may be open or inset.

CFR – Code of Federal Regulations

CRC – Cultural Resources Commission, County of Maui

CRM – Concrete Rubble Masonry wall constructed of mortared native rock.

DOT-H – Department of Transportation, Highways Division, State of Hawai‘i

Efflorescence – Mineral deposits on concrete surfaces indicating water penetration that can accelerate rusting of internal steel reinforcement.

FHWA – Federal Highway Administration

Girders – Horizontal beams resting on the abutments and support piers to carry the bridge deck.

HABS - Historic American Building Survey

HAER – Historic American Engineering Record

HBRRP – Highway Bridge Replacement and Rehabilitation Program

In situ – To remain in its original place.

ISTEA – Intermodal Surface Transportation Efficiency Act

Makai – Seaward or downstream side.

Mauka – Landward or upstream side.

NPS – National Park Service

GLOSSARY OF TERMS AND ACRONYMS (Continued)

NRHP – National Register of Historic Places

NSB – National Scenic Byways

Parapet – A low wall design used for bridge railings.

Piers – Structures within the stream bed supporting the spans of a bridge between the abutments.

Rebar – Steel reinforcement bars within concrete.

Scaling – Flaking surface concrete as a result of weathering or water saturation.

SHPD – State Historic Preservation Division, Department of Land and Natural Resources, State of Hawai‘i

Spall – Breakage and loss of concrete caused by internal pressure of rusting steel reinforcement.

Span – The section of bridge between the abutments and/or supporting piers. Single-span bridges have no supporting piers.

Superstructure – The part of the bridge resting on its abutments and piers, including the deck and railings.

TEA – Transportation Enhancement Activities

TEA-21 – Transportation Equity Act for the 21st Century

Thrie-beam – A structurally stronger variation of the steel w-beam.

Understructure – The structural system supporting the bridge deck. Includes the abutments, piers, arches, etc.

U.S.C – United States Code – Federal Law

USGS – United States Geological Survey

W-beam – A corrugated steel beam commonly used for guardrails.

Wing walls – Retaining walls extending laterally from the bridge abutment stabilizing the banks of the stream.

PREFACE

This Final Preservation Plan for County of Maui Bridges Within the Hāna Highway Historic District has been prepared in partial fulfillment of a conditional finding of "no significant effect" by the State Historic Preservation Division (SHPD), Department of Land and Natural Resources, State of Hawai'i for the proposed replacement of Papahawahawa Bridge, which is located within the Hāna Highway Historic District. The condition states that "A preservation Plan for County-owned bridges will be prepared prior to replacement of any subsequent County bridge. The DPWWM will work cooperatively with the SHPD toward preparing a preservation plan acceptable to both agencies." The Final Preservation Plan represents the culmination of community and agency involvement through public meetings as well as public review and comment of the Revised Draft Preservation Plan dated May 2001. On December 3, 2001, the SHPD concurred with this preservation plan (See Appendix G).

1. INTRODUCTION

The establishment and nomination of the Hāna Highway Historic District to the National Register of Historic Places was proposed in the *State of Hawaii Historic Bridge Inventory and Evaluation* (Draft Report - May 1996). On March 2, 2001, the Maui County Cultural Resources Commission nominated the Historic District to the Hawai‘i State and National Register of Historic Places. On March 19, 2001, the Hāna Highway Historic District was listed on the Hawai‘i State Register of Historic Places. Listing on the National Register followed on June 15, 2001.

The Hāna Highway Historic District extends from Hō‘alua Bridge near Huelo in the Makawao District to Koukou‘ai Bridge in the Kīpahulu District (See Figure 1). Within this Historic District are 59 bridges and 8 culverts that can be eligible for listing in the National Register of Historic Places because they are over 50 years old. Of these 67 structures, 51 are under the jurisdiction of the State of Hawai‘i. These State bridges and culverts are located along and carry the State's Hāna Highway (Route 360) from Hō‘alua Bridge through the town of Hāna. South of Hāna town, the highway falls under County jurisdiction, including 14 bridges (See Figure 2). Photographs of the 14 County bridges are included in Appendix A.

A section of Hāna Highway also traverses Haleakalā National Park, which is under federal jurisdiction. Based on the 1983 U.S. Geological Survey (USGS) Kīpahulu Quadrangle Map, there are two bridges within this section of the highway (Pualu‘u Bridge and ‘Ohe‘o Bridge). According to the National Park Service (NPS), the section of highway traversing the Park has only one bridge (‘Ohe‘o Bridge). Moreover, the NPS indicates that the highway and bridge may be part of the County's right-of-way through the Park and, therefore, may be under County jurisdiction. For the purpose of this Preservation Plan, only the 14 bridges which the County acknowledges are within its jurisdiction are addressed.

1.1 Purpose

The purpose of this Preservation Plan is provide the County of Maui with a comprehensive approach to managing its 14 bridges within the Hāna Highway Historic District in consideration of their historic resource value, public safety, and Federal funding opportunities that could minimize fiscal impact to the County. The historic resource value of these bridges is associated with their age, having survived more than a half-century of change in the region and island they serve. These changes have resulted in transportation demands and public safety considerations that would have been inconceivable when they were built. Due to their aging condition and the high volume of traffic the bridges presently carry, addressing public safety has become a paramount concern for the County.

Addressing public safety while preserving historic resource value requires creative solutions and, often, difficult choices. In the United States, public safety on the nation's streets and highways is largely defined by evolving design standards and guidelines for building new transportation facilities and for replacing or rehabilitating older facilities. These design standards and guidelines often conflict with efforts to preserve historic transportation facilities because modifications required to meet them would detract from or eliminate the features that define their historic character.

The role of design standards and guidelines in defining public safety for transportation facilities and the responsibility of transportation agencies in providing safe transportation facilities is also being defined by the courts through judgements in tort liability cases involving traffic accidents on public transportation facilities. Design standards and guidelines are also tied to the use of federal funds available to State and local transportation agencies for building, replacing and rehabilitating transportation facilities. Opportunities to use federal funds for its transportation projects are an important consideration to the County in managing its budget.

This Preservation Plan documents the process and rationale used in formulating management recommendations seeking a balance among historic preservation, public safety, and budgetary considerations for the County's bridges in the Hāna Highway Historic District.

1.2 Process

The process used in preparing this Preservation Plan included the following steps, which are documented in Sections 1 through 7, respectively:

1. Review **Historic Bridge Inventories and Evaluation Studies (1990 and 1996)** for the County bridges;

2. Review **Preservation and Rehabilitation Guidelines** for historic bridges;

3. Prepare an inventory of **Historic Character Defining Features** of the County bridges;

4. Review **Public Safety** considerations, including applicable **Design Standards, National Bridge Inspection Program** ratings for the County bridges and **Tort Liability** issues;

5. Review **Federal Funding Alternatives**;

6. Conduct **Community and Agency Consultation**; and

7. Develop **Recommendations** in consideration of historic preservation, public safety, funding alternatives and community and agency input.

1.3 Bridge Names

The names of the 14 County bridges have not been entirely consistent in the various maps, reports, and inventories researched. For this Preservation Plan, Pukui's *Place Names of Hawai'i* (1974) was consulted to confirm, where possible, the names of the bridges, spellings and diacritical markings. Table 1 lists the bridge names used in this Preservation Plan in the sequence they are crossed travelling from Hāna to Kīpahulu along Hāna Highway. Also shown are other names that have been used to identify these bridges. For consistency, where other reports or inventories are cited herein, the names used in those documents have been converted to those in Table 1.

Table 1: Bridge Names
Kaholopoʻo Bridge (Haneoʻo Stream Bridge)
Kahawaiokapiʻa Bridge (Kapiʻa Stream Bridge)
Waiohonu Bridge (Waiohonu Stream Bridge)
Papahawahawa Bridge (Papaʻahawahawa Stream Bridge)
ʻAlaalaula Bridge (ʻAlaalaua Stream Bridge)
Waikakoi Bridge (Waikakoi Stream Bridge)
Paihī Bridge (Paihī Stream Bridge)
Wailua Bridge (Wailua Stream Bridge)
South Wailua Bridge (Honolewa Bridge, Honolewa Stream Bridge)
Puʻuhaoʻa Bridge (Puʻuhaoʻa Stream Bridge)
Waiʻele Bridge (Paehala Bridge, Waiʻele Stream Bridge)
Mahalawa Bridge (Kakiweka Stream Bridge)
Hāhālawe Bridge (Hāhālawe Stream Bridge)
Koukouʻai Bridge (Kouʻkouʻai or Kaukauʻai Gulch/Stream Bridge)

2. HISTORIC BRIDGE INVENTORIES AND EVALUATIONS

The County bridges in the Hāna Highway Historic District were inventoried and evaluated in two studies: the ***Historic Bridge Inventory and Evaluation: Islands of Maui and Molokaʻi*** (September, 1990); and, the ***State of Hawaii Historic Bridge Inventory and Evaluation*** (Draft Reports of March, 1996 and May, 1996). Both of these documents assess the historic resource value of the County bridges, as summarized below.

2.1 Historic Bridge Inventory and Evaluation: Islands of Maui and Molokaʻi (September 1990)

This study was prepared by the Hawaiʻi Heritage Center for the State of Hawaiʻi, Department of Transportation - Highways Division (DOT-H).

The purpose of the study was to identify bridges that may qualify for nomination to the National Register of Historic Places (NRHP). The Federal Surface Transportation and Uniform Relocation Assistance Act requires each State highway agency to prepare an inventory of its historic bridges.

The inventory includes bridges over 50 years old at the time it was prepared and documents basic information such as their location, type by structure and material, and the facility (roadway) they carry. The evaluation included a point rating system grouped by three overall categories comprised of two or more sections within which points were assigned:

- **Environmental**

  Integrity - Points credited for Location and Setting, Workmanship, Design, Feeling and Association, and Material.

  Aesthetics - Rated Poor, Average, or Excellent.

  History (associated with bridge) - Rated Poor, Average, or Excellent.

- **Documentation**

  Builder/Designer - Rated as: Unknown, Known, Known-Prolific, or Known-Noted.

  Construction Date - Rated by age: 1936-1940, 1926-1935, 1911-1925 and Pre-1910.

- **Technology**

  Technical - Points credited for Number of Spans, Span Length, Height and Special Features.

  Geometric Configurations - Rated as: Unique, Unusual or Typical.

The point breakdown for the 14 County bridges in the Hāna Highway Historic District (which had not been conceived at the time) is shown in Table 2.

Based on the point scores earned in the evaluation, the bridges were placed in one of three categories:

- **Category I:** Rated "good," these bridges earned between 25 and 29 points (none of the County bridges in the Hāna Highway Historic District were in this category);

- **Category II:** Rated "fair," these bridges earned between 20 and 24 points (one County bridge, Koukou‘ai Bridge, in the Hāna Highway Historic District, was in this category, earning 21 points); and

- **Category III:** Considered as having little local, state or national significance, these bridges earned between 8 and 19 points (The 13 other County bridges in the Hāna Highway Historic District were in this category).

The study concluded that eight bridges on Maui and Moloka‘i, although only seven were listed in Category I and II, may qualify for inclusion in the NRHP (the discrepancy in count was not explained in the document). As mentioned previously, only one County bridge in the Hāna Highway Historic District, Koukou‘ai Bridge, fell in Category II.

Table 2
1990 Ratings of County Bridges in the Historic Bridge Inventory and Evaluation: Islands of Maui and Molokaʻi (September 1990)

	ENVIRONMENTAL			DOCUMENTATION		TECHNOLOGY		
Bridge	**Integrity**	**Aesthetics**	**History**	**Builder/ Designer**	**Year Built**	**Technical**	**Configuration**	**Total**
Kaholopoʻo Bridge	10	0	0	0	3	1	0	14
Kahawaiokapiʻa Bridge	12	0	0	0	3	1	0	16
Waiohonu Bridge	11	2	0	0	3	1	0	17
Papahawahawa Bridge	11	2	0	0	3	1	0	17
ʻAlaalaula Bridge	10	0	0	0	3	0	0	13
Waikakoi Bridge	11	2	0	0	3	1	0	17
Paihī Bridge	10	2	0	0	3	0	0	15
Wailua Bridge	Not Rated (Constructed in 1947, this bridge was less than 50 years old at the time)							
South Wailua Bridge	11	2	0	0	3	1	0	17
Puʻuhaoʻa Bridge	9	2	0	0	4	0	0	15
Waiʻele Bridge	11	2	0	0	4	0	0	17
Mahalawa Bridge	9	2	0	0	4	0	0	15
HāhālaweBridge	12	2	0	0	4	0	0	18
Koukouʻai Bridge	13	3	0	0	3	0	2	21

2.2 State of Hawaii Historic Bridge Inventory and Evaluation (Draft Reports - March and May 1996)

This study was prepared by Spencer Mason Architects for the State DOT-H.

The intent of this study was to provide a comprehensive list of Federal, State, and County bridges, statewide, that are eligible for the listing in NRHP. The study initially involved the analysis of 379 potentially historic bridges constructed between 1894 and 1941 on the islands of O'ahu, Hawai'i, Maui and Kaua'i. The bridges on Maui were identified in the ***Historic Bridge Inventory and Evaluation: Islands of Maui and Moloka'i*** *(September, 1990)*, discussed previously. In addition, several bridges that were not yet fifty years old, but which were regarded as contributing resources to the concept of a Historic District, were also included in the study. One of these was a County bridge, Wailua Bridge, which was constructed in 1947. It had since met the eligibility criterion of being more than 50 years old.

Potentially historic bridges were assessed for their significance with respect to criteria employed by the NRHP and the Historic American Engineering Record (HAER).

The rating system was based on one hundred possible points. Forty-five points related to the Critical Integrity criteria of the National Register. Another forty-five related to the lettered National Register criteria. The remaining ten points were for HAER criteria. In all, more than half of the possible points related to objective and technological factors, about one-third to historic considerations, and the remainder to subjective factors such as aesthetic characteristics. The criteria are described below, beginning with National Register Critical Integrity criteria:

- **Integrity Criteria**

  Integrity of Location (up to 7 points) - Relates to whether a bridge has been moved from the original site.

  Integrity of Design (up to 7 points) - Concerns the continuance of the original design elements of a bridge

  Integrity of Setting (up to 7 points) - Concerns the character of the environment of the resource, and whether changes in the setting have compromised the relationship of a bridge to its surroundings.

  Integrity of Materials (up to 7 points) - Evaluates whether the original materials used to construct a bridge have been substantially altered by deterioration or replacement.

Integrity of Workmanship (up to 7 points) - Concerns the type of craftsmanship as well as the methodology of assembly.

Integrity of Feeling (up to 5 points) - Concerns the embodiment of a sense of history and whether that quality is communicated by a bridge.

Integrity of Association (up to 5 points) - Relates to the interpretation of a bridge, in the context of historic periods, trends, or events.

Other lettered National Register criteria include:

- **Events** (up to 5 points) - National Register Criterion A, which overlaps the HAER guidelines, relates to a property's contributions to the economic or industrial development of an area and its significance in the history of a branch of engineering.

- **Persons** (up to 5 points) - National Register Criterion B relates to the association of a structure to a historic person.

- **Distinctive Characteristics** - National Register Criterion C relates to the following:

  Type (up to 5 points) – A bridge's uniqueness with regard to the number of examples of its structural type in the State or County.

  Period (up to 5 points) – A bridge's distinction as an example of a period of bridge construction.

  Method of Construction/Engineering Complexity (up to 5 points) - The main technological component of bridge evaluation.

  Work of a Master (up to 5 points) - The level of historic recognition achieved by the designer or builder of a bridge.

  High Artistic Design (up to 5 points) – A bridge's overall design, or certain ornamental elements.

  Distinguishable Entity (up to 5 points) – Any important feature or characteristic in a bridge's design or history that gives it a distinctive identity.

  Information Content (up to 5 points) – A bridge's potential to yield important information that may contribute to the understanding of human history.

HAER Guidelines

- **Early Engineering Structure** (up to 5 points) - Considers a bridge's design type as representing the earliest or among the earliest examples in a County.

- **Representative Example** (up to 5 points) - Considers a bridge's design type as the best single example or a good example in a State or County.

Based on the point scores earned in the evaluation, the March, 1996 Draft Report placed the bridges in one of three categories:

- **Category I:** Determined to be eligible for the NRHP, these bridges received sixty (60) points or greater. Three County bridges (South Wailua, Hāhālawe, and Koukou'ai Bridges) in the Hāna Highway Historic District were placed in this category;

- **Category II:** Determined to be potentially eligible for the NRHP, these bridges received between 35 and 59 points. The remainder of the County bridges in the Hāna Highway Historic District are assumed to have fallen in this category, as explained below; and,

- **Category III:** Determined to be ineligible for the NRHP, these bridges received less than 35 points. Only one of the 105 bridges rated in the study fell in this category and it was subsequently dropped from the study.

As a result of the initial categorization, all except one of the 105 bridges evaluated would have been in either Category I or II and, therefore, subject to review under Section 106 National Historic Preservation Act. At the direction of the State DOT-H, the ratings were re-evaluated to include a determination of either "eligible" (Category I) or "not eligible"(Category II) for listing in the NRHP, thus eliminating the "potentially eligible" (Category II) designation.

As a result of the re-evaluation, which is documented in the May, 1996 Draft Report, the threshold for Category I was lowered to approximately 58 points to include the higher-rated Category II bridges while bridges below the threshold were relegated to Category III. In addition, two Historic Districts were proposed, one of which was the Hāna Highway Historic District, within which all inventoried bridges are regarded as contributing resources to the District.

All bridges in Category I were proposed for nomination to the NRHP. Of the 70 Maui bridges proposed for nomination, 67 were to be part of the Hāna Highway Historic District, while the other three were proposed to be individually nominated. Only three bridges in the Hāna Highway Historic District were identified with point totals that would

have qualified them for individual nomination, the rest were not rated. Of these, only one, Koukou'ai Bridge, which received a score of 75, is under County jurisdiction. Point totals were not indicated for the County's South Wailua Bridge and Hāhālawe Bridge which were initially rated with point totals of 68 and 70, respectively.

2.3 Preservation and Rehabilitation Guidelines

The ***State of Hawaii Historic Bridge Inventory and Evaluation*** (Draft Report, May 1996) prepared by Spencer Mason Architects for the State DOT-H provides Detailed Preservation and Rehabilitation Guidelines for historic bridges (See Appendix B). These guidelines, summarized below, are presented in four categories. The first three are in descending order of preference for preserving the historic value of a bridge while the fourth pertains specifically to bridges in Historic Districts:

1. **Continued Use for Vehicular Purposes** - This category includes guidelines in three sub-categories based upon a bridge's limitations:

    - Structural Upgrading - These guidelines address a bridge's structural limitation in accommodating traffic. Initially recommended is consideration of non-structural measures such as load limits. If modifications are required, methods that would minimize alteration of character-defining visual qualities of the original structural system are suggested.

    - Geometric Modification - These guidelines address the limitations that a bridge's geometric configuration, including its width and height clearance, would impose on traffic. Initially recommended are measures such as holding lanes, speed restrictions and signals to better accommodate continued use of a single-lane bridge. Other preservation alternatives include relocating a visually compatible historic bridge to an adjacent site to carry a second lane, or constructing a visually compatible second bridge to carry a second lane. If modifications are required, aesthetically and historically appropriate measures are suggested such as external sidewalks, and cantilevered decks.

    - Materials Repair and Maintenance - These guidelines pertain to the selection of materials and methods of repairing bridges to preserve features that are important in defining the overall historic character of a bridge. Specific guidelines are provided for masonry superstructure and substructure, metals and wood.

    - Removal to a Less Demanding Site - These guidelines provide a procedure for finding and relocating a historic bridge.

2. Continued Use for Non-vehicular Purposes - This category provides guidelines in three sub-categories in descending preference, once it has been determined that vehicular use is not feasible.

- Retain the Bridge in a Transportation or Transportation-Related Use - These guidelines provide an approach to considering alternatives such as bicycle or pedestrian crossings in a manner that will preserve a bridge's historical character.

- Consideration of Non-transportation Uses - These guidelines suggest consideration of retaining the bridge for public recreational use, as an interpretive site or museum, or architectural adaptations that could provide residential, commercial or educational space *in situ* or within a historic district.

- Retention as a Historical Ruin or Monument - As a last resort for preservation, this guideline suggests consideration of retaining the bridge as a historical ruin or monument in place or at an alternate location.

3. Replacement With Mitigation

When all alternatives for preserving a bridge have been exhausted and the bridge is to be demolished, two mitigation measures should be pursued:

- Documentation - These guidelines provide a procedure for documenting information prior to demolition. Three levels of documentation have been established by the NPS: Level I for bridges of national significance; Level II for bridges of state significance; and, Level III for bridges of local significance.

- Storage and/or Salvage - These guidelines delineate the purpose and procedures for the storage and salvage.

4. Special Considerations for Bridges Located in Historic Districts

Three sub-categories of guidelines for bridges in a Historic District are provided:

- Identify Important Characteristics of the District - In consultation with the State Historic Preservation Division, identify the features that are important in defining the overall historic character of the district and the character-defining features of the historic bridge and its relationship to the district.

- Treatment of Bridges in Historic Districts - This guideline specifies that rehabilitation consider the previously described options for **Continued Use**

for Vehicular Purposes and **Continued Use for Non-vehicular Purposes**. When a bridge cannot be upgraded or the site precludes other uses, then it may need to be replaced with mitigation, including documentation. The design of the replacement bridge should consider its compatibility within the historic district.

- Design of New Bridges, Including Replacement Bridges - These guidelines pertain to the design and selection of materials for new bridges to preserve the historic relationship of the bridge with its site.

3. HISTORIC CHARACTER-DEFINING FEATURES

The Hāna Highway Historic District provides the context for assessing the historic resource value of the County bridges. While earlier inventories assessed the historic resource value of individual bridges in a local, state and national context, the bridges in the Hāna Highway Historic District also need to be assessed in the context of their contribution to the character of the Historic District. Toward assessing this contributory role of the County bridges, the historic architecture services of Mason Architects was enlisted to inventory the historic character-defining features of each County bridge. This inventory is presented in Table 3.

In general, the historic character of the Hāna Highway Historic District is defined not only by the individually significant bridges within the District, but by the contributing aesthetic characteristics of all of the bridges. The primary character defining features of the bridges are those that are readily visible along the highway. For most of the County bridges, the primary view is along the approach. Hence, the defining features are those atop the bridge, including the narrow single-lane deck, unique railings, and inscriptions. The absence of approach guardrails to most of the bridges is also a defining feature. For several bridges, the primary view is of their makai side (elevation view) from the approach road. Bridges with this feature include Kaholopoʻo Bridge, ʻAlaalaula Bridge, Paihī Bridge, South Wailua Bridge, Waiʻele Bridge and Hāhālawe Bridge. Hence, defining features include the makai railing and understructure, as well as wing walls (retaining walls extending laterally from the abutments).

Bridge features that are not readily visible from the highway contribute less toward defining historic character. For bridges with obscured understructures, defining features may include concrete-rubble-masonry (CRM) retaining walls, abutments (walls supporting the deck on either side of the stream), and mid-span supports, as well as arch structural systems. The exception is Koukouʻai Bridge, which is an individually significant historic bridge. Although the unique arch understructure of this bridge cannot be seen from the road, it is a defining feature of the bridge.

Other defining features include the setting associated with the bridge, particular the adjacent waterfalls at ʻAlaalaula Bridge, Paihī Bridge, South Wailua Bridge and Hāhālawe Bridge.

Table 3: Historic Character-Defining Features

	YEAR BUILT	STRUCTURAL SYSTEM	RAIL TYPE	INSCRIPTION	ABUTMENT	SUPPORTS	APPROACH GUARDRAILS	WING WALL	VIEWS	MISC.
General features of the district:		Girder, slab and tee-beam bridges with simple short, spans; reinforced-concrete, often with evidence of horizontal board form-work; white paint on inside of rails/ parapets	Solid parapets or open balustrades	Only on solid parapet-type bridges	CRM or concrete	CRM or concrete	Generally no approach guardrails, few CRM guardrails and few added steel guardrails that are distracting features	Occasional low CRM walls along approaches	Lush vegetation and highly visible waterfalls	Generally located at the curve of the road in the rear of the valleys over shallow, narrow streams
Kaholopoʻo (Haneoʻo) Stream Bridge	1917	Reinforced-concrete slab structural system	None (Historic rail missing / replaced with metal guardrail)	None	CRM	CRM	None	CRM	Primary - downstream elevation from roadway; secondary - along approach	Evidence of CRM abutments of earlier bridge immediately upstream
Kahawaiokapiʻa (Kapiʻa) Stream Bridge	1915/ 1931	Reinforced-concrete girder with board form-work on deck and parapets (7" wide boards at downstream rail and 12" wide boards at upstream rail); parallel parapets with trapezoidal skew	Solid flush reinforced-concrete parapet with peaked top (40" h.); Upstream parapet is original; downstream parapet added c. 1931 original parapet has ogee reveal at cap and ends	"AD 1915" incised on inside of upstream rail	CRM	Two concrete intermediate piers	None	CRM	Primary view along approach	
Waiohonu Stream Bridge	1915	Reinforced-concrete tee-beam structural system	Open balustrade with gently peaked rail cap (32" h); five rail panels with intermediate posts; parallel rails; end piers (12" sq) with recessed panel and overhanging peaked rail cap	None	CRM abutment (obscured by plants)	Four piers (one CRM, three concrete)	None	CRM	Primary - along approach; secondary - from streambed (far downstream)	
Papahawahawa Stream Bridge	1913 / 1915	Reinforced-concrete slab (c. 1913) and girder structure (c. 1915) with board form-work on deck and rails; trapezoidal skew to deck, girders and pier	Solid paneled reinforced-concrete parapet with peaked rail cap (+/-24" h.); Parallel rails	Mirror image "AD 1913" incised on outside of rail at slab span	CRM	CRM pier	None	CRM	Primary view along approach; secondary view from adjacent residence	See HAER no. HI-34 for further information
ʻAlaalaula Stream Bridge	1915	Reinforced-concrete girder with evidence of board form work on deck and rails	Solid reinforced-concrete parapet with peaked rail cap (+/-30" h.); Outward cant of rail on downstream side	"1915" incised on outside of down-stream rail	Concrete	None (single span)	CRM	None	Primary – downstream elevation from road; secondary – along approach	Adjacent waterfall and mature (mango) trees
Waikakoi Stream Bridge	1911	Reinforced-concrete slab and girder structural system with evidence of wide board form-work on deck and rails	Solid paneled reinforced-concrete with peaked rail cap (21" h.) at up-stream side; solid flush-face parapet with square top at downstream	None	CRM	Arched concrete central pier	Steel	CRM	Primary - along approach	
Paihī Stream Bridge	1911	Reinforced-concrete longitudinal girder structural system with trapezoidal skew to perpendicular beams and deck	Solid flush-face reinforced - concrete with peaked top (24" w & h.)	"AD" "1911" incised on approach ends of parapets	Concrete	None (single span)	Steel and CRM	None	Primary - downstream elevation from roadway; secondary - along approach	Adjacent waterfall
Wailua Stream Bridge	1947	Reinforced-concrete tee-beam structural system slightly curved rails with slight trapezoidal skew to deck	Reinforced- concrete horizontal rails with intermediate posts	"Wailua" "1947" incised on end piers	Concrete	None (single span)	Concrete bollards and steel guardrails	Concrete	Primary - along approach	

Table 3: Historic Character-Defining Features (continued)

	YEAR BUILT	STRUCTURAL SYSTEM	RAIL TYPE	INSCRIPTION	ABUTMENT	SUPPORTS	APPROACH GUARDRAILS	WING WALL	VIEWS	MISC.
South Wailua (Honolewa) Stream Bridge	1911	Reinforced-concrete girder structural system	Solid flush-face reinforced- concrete parapet with peaked rail cap (20" high)	"AD 1911" incised on outside of down-stream parapet	Concrete	Arched central pier	CRM	None	Primary - downstream elevation from roadway; secondary - along approach	Adjacent waterfall and extensive pedestrian traffic
Puʻuhaoʻa Bridge	1910	Reinforced-concrete girder structural system	Open balustrade w/ ornamental openings and square railcap (30" h) (rail type similar to Oheo Gulch Bridge); end piers (15" sq) with recessed panel and overhanging square railcap	"AD 1910" and "20 TONS" incised on approach side of end piers	Concrete	None (single span)	None	CRM	Primary view along approach	
Waiʻele (Paehala) Stream Bridge	1910	CRM solid-spandrel arch with cut basalt arch ring with concrete lining	Solid flush-face reinforced- concrete parapet with square rail cap downstream (28" h.); Simple flush-face parapet upstream (most likely from a later date)	"AD 1910" in raised letters on outer side of down-stream parapet	CRM	None (single span)	CRM	CRM	Primary - downstream elevation from roadway; secondary - along approach	
Mahalawa (Kakiweka) Stream Bridge	1910	Reinforced-concrete girder structural system with trapezoidal skew to deck	Solid flush-face reinforced- concrete parapet with square rail cap (20" high)	None	Concrete	None (single span)	CRM	CRM	Primary – along approach	
Hāhālawe Stream Bridge	1910	CRM solid-spandrel arch with cut basalt arch ring with concrete lining	Solid flush-face reinforced- concrete parapet and square rail cap with ogee detail downstream; simple flush-face parapet upstream	"AD 1910" in raised letters on outside of down-stream parapet	CRM	None (single span)	CRM	None	Primary – downstream elevation from roadway; secondary - along approach	Adjacent waterfall
Koukouʻai Stream Bridge	1911	Reinforced-concrete open-spandrel arch	Solid paneled reinforced-concrete parapet with peaked rail cap (+/-12" high)	"AD 1911" incised on outer side of down-stream parapet	CRM	None (single span)	None	None	Primary view along approach: secondary view from pools upstream	

4. PUBLIC SAFETY

Public safety is a critical concern for the County bridges as they were constructed more than a half-century ago when automobiles were just emerging as a viable form of transportation, particularly in this rural area. It would have been unimaginable when they were built that these bridges would be called upon to safely carry the high volumes of automobile traffic and weight loads that they currently do. The length of time these bridges have been in service has also taken a toll on their structural integrity so they are even less capable of handling the type of traffic for which they were designed, much less the traffic they currently carry.

Public safety considerations pertinent to the Preservation Plan include current **Design Standards** for bridges, the **National Bridge Inspection Program** ratings for the County bridges**,** and **Tort Liability** issues.

4.1 Design Standards

Over almost a century since the first of the County bridges in the Hāna Highway Historic District were built, designers of transportation facilities have greatly advanced their knowledge of safe road and bridge design. Toward making this information available for all designers to use, the American Association of State Highway and Transportation Officials (AASHTO) publishes a document entitled ***A Policy on Geometric Design of Highways and Streets***. Popularly referred to as AASHTO's "green book", the latest update was published in 1996. The "green book" provides recommended guidelines for all aspects of roadway design from neighborhood streets to major highways.

In Hawai'i, the State DOT-H as adopted AASHTO's recommended guidelines as design standards for all new transportation facilities in its ***Statewide Uniform Design Manual for Streets and Highways*** (October, 1980 as updated to include AASHTO's 1984 recommendations).

In addition, AASHTO has developed recommended guidelines for the design of bridges, as documented in its ***Standard Specifications for Highway Bridges***, 16th Edition, 1996.

Based on current design standards, the County bridges in the Hāna Highway Historic District should have the following features:

- Load rating of at least 15 tons;
- Structural integrity capable of withstanding seismic (earthquake) forces;
- Erosion protection to prevent undermining of bridge abutments (walls supporting the bridge deck on either side of the stream) and support piers;
- Two traffic lanes, and a railing-to-railing width of at least 28-feet;

- Crash-tested railings to keep errant vehicles on the bridge without causing them to spin or vault in a collision;
- Guardrails on both sides of road approaches extending from the railings to safely deflect errant vehicles from crashing head-on into the railing ends;
- Approach road and deck alignment (geometry) providing adequate sight distance for drivers to safely negotiate the crossing;
- All required signage, including road striping, reflectors and posted traffic signs; and
- Hydraulic capacity to safely pass storm flows to prevent upstream flooding and flows from overtopping the bridge deck.

4.2 National Bridge Inspection Program

The County of Maui conducts periodic bridge inspections in compliance with Federal Highway Administration requirements as set forth in the Code of Federal Regulations (CFR) 23 Highways - Part 650, Subpart C - National Bridge Inspection Standards. These regulations provide the rationale and requirements for Bridge Life Safety Inspection of bridges located on roads subject to public use. Some notable points of this code include:

- Each qualifying bridge is required to be inspected at regular intervals not to exceed two years;

- Each bridge to be inspected must be rated as to its safe load carrying capacity in accordance with the "Manual for Maintenance Inspection of Bridges" by AASHTO; and

- All inspection records and bridge inventories must be prepared and maintained in the manner established by the AASHTO Manual.

The Sufficiency Rating is an overall numerical rating of the level of service that a bridge provides in relation to the roadway it serves. The rating is based on a 100-point scale with 100 representing a bridge fully meeting current design standards. The Sufficiency Rating considers both the structural and functional aspects of a bridge. A Structurally Deficient bridge is one that has been restricted to lighter vehicles, requires immediate rehabilitation to remain open, or has been closed. A Functionally Obsolete bridge is one in which the deck geometry, load capacity, clearance, or approach road alignment no longer meet the usual criteria for the transportation system it serves. Table 4 presents the Sufficiency Ratings for the 14 County bridges in the Hāna Highway Historic District based on the most recent bridge inspection reports.

TABLE 2 BRIDGE SUFFICIENCY RATINGS	
Bridge	**Sufficiency Rating**
Kaholopoʻo Bridge	2.0
Kahawaiokapiʻa Bridge	15.9
Waiohonu Bridge	14.0
Papahawahawa Bridge	2.0
ʻAlaalaula Bridge	3.0
Waikakoi Bridge	34.2
Paihī Bridge	4.0
Wailua Bridge	57.0
South Wailua Bridge	37.1
Puʻuhaoʻa Bridge	11.6
Waiʻele Bridge	12.0
Mahalawa Bridge	18.8
Hāhālawe Bridge	5.3
Koukouʻai Bridge	2.0

In general, all 14 County bridges in the Hāna Highway Historic District are Functionally Obsolete due to inadequate load capacity, narrow lane widths, and other deficiencies. The following ten bridges were rated Structurally Deficient and in need of immediate attention:

1. **Kaholopoʻo Bridge:** Kaholopoʻo Bridge is a one-lane reinforced concrete flat slab bridge constructed in 1917. This bridge has a roadway width of 15.1 feet, an operating load rating of 4.3 tons and a posted weight limit of 3 tons. According to the latest bridge inspection report, dated October 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 2.0 included collision damage, spalling concrete, exposed rebar, undermining of the bridge abutments, section loss, vegetation growth, efflorescence and water stains.

2. **Kahawaiokapiʻa Bridge:** Kahawaiokapiʻa Bridge is a one-lane reinforced concrete deck girder bridge which was constructed in 1915. This bridge has a roadway width of 15.4 feet, an operating load rating of 9.9 tons and a posted weight limit of 8 tons. According to the latest bridge inspection report, dated October 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 15.9 include spalling concrete, exposed rebar, section loss, collision damage and scaling.

3. **Waiohonu Bridge:** Waiohonu Bridge is a one-lane reinforced concrete deck girder bridge which was constructed in 1915. This bridge has a roadway width of 15.4 feet, an operating load rating of 16.1 tons and a posted weight limit of 12 tons. According to the latest bridge inspection rating report, dated October 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 14.0 include spalling concrete, exposed rebar, collision damage, efflorescence, waterstains, scaling, section loss to the rebar, undermining, and water leakage.

4. **Papahawahawa Bridge:** Constructed in 1915 Papahawahawa Bridge is a one-lane reinforced concrete deck girder bridge. This bridge has a roadway width of 14.4 feet, an operating load rating of 4.7 tons and a posted weight limit of 5 tons. According to the latest bridge inspection rating report, dated October 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 2.0 included scaling, section loss, spalling concrete, exposed rebar, water leakage, efflorescence, undermining, and vegetation growth.

5. **ʻAlaalaula Bridge:** ʻAlaalaula Bridge is a one-lane reinforced concrete deck girder bridge which was constructed in 1915. This bridge has a roadway width of 12.5 feet, an operating load rating of 9.9 tons, and a posted weight limit of 7 tons. According to the latest bridge inspection rating report, dated August 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 3.0 included collision damage, spalling concrete, exposed rebar, and vegetation growth.

6. **Paihī Bridge:** Constructed in 1911, Paihī Bridge is a one-lane reinforced concrete deck girder bridge. This bridge has a roadway width of 13.8 feet, an operating load rating of 9.5 tons, and a posted weight limit of 8 tons. According to the latest bridge inspection rating report, dated June 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 4.0 included spalling concrete, heavy waterstaining, vegetative growth, section loss, efflorescence, exposed rebar, and scaling.

7. **Puʻuhaoʻa Bridge:** Constructed in 1910, Puʻuhaoʻa Bridge is a one-lane reinforced concrete deck girder bridge. This bridge has a roadway width of 14.4 feet, an operating load rating of 15.0 tons, and a posted weight limit of 12 tons. According to the latest bridge inspection rating report, dated August 1997, structural deficiencies which contributed to the bridge's Sufficiency Rating of 11.6 included collision damage, section loss, spalling concrete, exposed rebar, hairline cracks, waterstains, and undermining of the abutment footing.

8. **Waiʻele Bridge:** Waiʻele Bridge is a one-lane masonry arch bridge which was constructed in 1910. This bridge has a roadway width of 12.5 feet, an operating load rating of 5.4 tons, and a posted weight limit of 5 tons. According to the latest

bridge inspection rating report, dated August 1997, structural deficiencies contributing to the bridge's Sufficiency Rating of 12.0 included plaster delaminating from the cut stone, water stains, efflorescence, spalling concrete, and exposed rebar.

9. **Hāhālawe Bridge:** Constructed in 1910, Hāhālawe Bridge is a one-lane masonry arch bridge. This bridge has a roadway width of 14.4 feet, an operating load rating of 5.2 tons, and a posted weight limit of 4 tons. According to the latest bridge inspection rating report, dated June 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 5.3 included spalling concrete, exposed rebar, collision damage, and delimination of plaster from the cut stone arch.

10. **Koukou'ai Bridge:** Koukou'ai Bridge is a one-lane reinforced concrete arch bridge which was constructed in 1911. This bridge has a roadway width of 15.1 feet, an operating load rating of 8.0 tons, and a posted weight limit of 8 tons. According to the latest bridge inspection rating report, dated August 1998, structural deficiencies contributing to the bridge's Sufficiency Rating of 2.0 included spalling concrete, exposed rebar, collision damage, water stains, efflorescence, and section loss.

4.3 Tort Liability

Tort liability attaches a monetary consideration to the concern for public safety. Because the County has a duty to provide safe transportation facilities, it could be sued if people are killed or injured in an accident caused by an unsafe facility.

The ten Structurally Deficient County bridges are a critical public safety concern due to the potential for structural failure. Although the County could justify closing these bridges to traffic on this basis, the impact of such closure on the community would be significant since each is part of the only continuous road around the eastern half of the island. By allowing its Structurally Deficient bridges to be used, the County has increased its tort liability risk.

Tort liability risk with regard to changing design standards is also an important consideration for improvements addressing the Structurally Deficient County bridges. In general, transportation facilities designed and built to the standards of their day will limit tort liability risk to the responsible transportation agency. Because design standards change over time, these agencies are not expected to upgrade their facilities every time a new standard is adopted. Nevertheless, Hawai'i case law suggests that when a facility is rehabilitated or improved, the agency should upgrade it to meet current standards.

In 1999, the Hawai'i Supreme Court upheld a Circuit Court judgement in the Taylor-Rice case, finding the State 20% liable and responsible for $1.5 million in damages awarded in

relation to a 1994 automobile accident on Kaua‘i. Two passengers were killed and a third severely injured in the accident when the intoxicated driver of the car hit the buried end of a guardrail, vaulting the car into a utility pole. The guardrail was installed before 1973 when a safer end treatment design was developed following crash tests that revealed the vaulting hazard of the buried end treatment. In 1990, the State resurfaced the highway but their existing policy did not allow maintenance funds to be used for upgrading the guardrail design to the current standard. The court determined that the "State was under a duty to improve the guardrail up to contemporary engineering standards as part of a 1990 road resurfacing project."

More recently, a Circuit Court judgement awarded $3.3 million to a motorist who sued the State for injuries rendering him a quadriplegic because the State had failed to install guardrails when a Hawai‘i Island road was resurfaced (See Appendix C). The State is appealing the judgement.

Inasmuch as the County has repeatedly resurfaced the decks of its bridges, it may already have increased its tort liability risk. More directly, however, these cases also imply that when the County replaces or rehabilitates its bridges, it could be found negligent in its duty is to design and construct safe transportation facilities if the replacement or rehabilitated bridges do not meet current design standards. The size of awards in these cases suggest that the possibility of even a single accident resulting in fatality or serious injury over the life of a replacement or rehabilitated bridge should be a significant consideration in bridge design. Any aspect of bridge design that does not meet current design standards increases tort liability risk. Meeting current design standards, however, limits options for preserving historic character defining features of the bridges.

5. FUNDING ALTERNATIVES

5.1 Design Standards and Exceptions

Since the County is responsible for maintaining its bridges, the County would be expected to use its funds to repair, rehabilitate or replace their bridges. In using its own funds for bridge improvements, the County has a duty to design and construct safe transportation facilities, but use of County funds is not tied to compliance with current design standards. As discussed previously, however, the County would be increasing its tort liability risk if current design standards are not met.

Federal-aid for improving County bridges is available through various programs, but all Federal-aid projects need to be "designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards." (23 U.S.C. 109 (p)) For Hawai'i, this means complying with the ***Statewide Uniform Design Manual for Streets and Highways*** (October, 1980) as updated to include AASHTO's 1984 recommendations. Federal-aid project requests by the Counties are processed by the State DOT-H.

Recognizing that certain conditions may preclude attaining full compliance with design standards, however, 23 CFR 625 provides that exceptions may be given on a case-by-case basis for designs that do not conform with current standards. Such cases may include extremely difficult situations or those requiring extraordinarily high costs for acquiring rights-of-way, or for construction to meet design standards. In addition, design exceptions may be considered for mitigating environmental impacts or the preservation of historic or scenic values of the location.

Design exceptions for Federal-aid projects must receive formal concurrence by the State DOT-H and the Federal Highway Administration (FHWA). Each design exception must be carefully weighed considering public safety as well as tort liability risks. The State DOT-H is particularly cognizant of the latter since it would be assuming some of the responsibility for concurring with a substandard design feature. From the County's perspective, the design exception process is advantageous because it conveys some of the tort liability risk to the State.

Historically, the State DOT-H has been reluctant to consider significant design exceptions for the County's Federal-aid bridge improvement projects. Since the State DOT-H is responsible for processing County requests for Federal-aid, projects requiring significant design exceptions were relegated to a lower priority, essentially eliminating them from contention for limited funds.

More recently, however, both the State DOT-H and the local FHWA office have taken greater interest in the County's dilemma in addressing its Structurally Deficient bridges in the Hāna Highway Historic District. Based on a review of other States' efforts,

particularly Vermont and Oregon, the State DOT-H and FHWA have indicated a willingness to consider allowing a design exception, on a case-by-case basis, for bridge width to address historic preservation concerns. Specifically, the design exception would allow County bridges in the Historic District to continue operating as single-lane bridges. A minimum bridge width of 16-feet has been discussed, based on ***Vermont State Design Standards*** (October 22, 1997) for bridges to remain in place on local roads and streets. To this end, on May 1, 2000 the FHWA concurred with a single-lane design exception for Kaholopoʻo Bridge (See Appendix D). The magnitude of this design exception is significant because the Vermont standard applies to local roads and streets with an Average Daily Traffic count of zero to 50 vehicles.

In the longer term, the National Scenic Byways (NSB) Program provides an opportunity for the State to develop design standards recognizing the historic and scenic qualities of highways designated through the program. Once adopted, these design standards would allow Federal-aid to be used for applicable bridges designed to those standards without requiring a design exception. The NSB Program is discussed in Section 5.6.

5.2 Highway Bridge Replacement and Rehabilitation Program (HBRRP)

The Surface Transportation Act of 1978 established the Highway Bridge Replacement and Rehabilitation Program (HBRRP) to help States improve the condition of the nation's bridges. The HBRRP has been continued by the Transportation Equity Act for the 21st Century (TEA-21). The HBRRP is the most accessible source of Federal-aid to the County for bridge replacement and rehabilitation projects. This is because the sufficiency rating derived through the National Bridge Inventory Standards is used to prioritize eligible projects. In general, the lower the sufficiency ratings of a bridge, the higher its priority. The extremely low sufficiency rating for the County's bridges in the Hāna Highway Historic District elevate their priority. Normally, the Federal share of the project cost through this program is 80 percent and the County share is 20 percent.

5.3 Transportation Enhancement (TE) Program

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) included the establishment of the TE Program, which offers broad opportunities and federal funds to take unique and creative actions to integrate transportation into communities and the natural environment. In 1998, the TE Program was reauthorized by TEA-21. TEA-21 defines Transportation Enhancement Activities (TEA) eligible for Federal-aid reimbursement, including historic preservation and the rehabilitation and operation of historic transportation buildings, structures or facilities. Normally, the Federal share reimbursed is 80 percent of the project cost. In Hawai'i, the State DOT-H administers the TE Program.

The TE Program is a potential source of Federal-aid for County bridge improvements because the bridges are in the Hāna Highway Historic District. The amount of funding

available to Hawai‘i is limited, however, and there is intense competition for those funds because of the broad eligibility criteria for TEA. Like other Federal-aid projects, TEA projects, including historic bridge improvements, would be subject to compliance with State design standards unless design exceptions are allowed.

5.4 Innovative Bridge Research and Construction Program

In 1998, TEA-21 established the Innovative Bridge Research and Construction Program. The program is intended to demonstrate the application of innovative material technologies, including funding for the repair, rehabilitation, replacement and new construction of bridges using innovative materials. Notably, this program provides Federal-aid for up to 100 percent of the project cost. As in the case of other Federal-aid programs, projects funded would be subject to compliance with State design standards unless design exceptions are allowed. A project seeking Federal-aid through this program would compete with other projects submitted to the State, as well as with other projects nationwide.

An innovative bridge rehabilitation technology that may qualify for this program is the use of composite materials to strengthen bridge understructures while preserving their appearance. Sometimes referred to as “fiber-wrapping”, this technology can strengthen concrete girders, and other structural members. Toward investigating this option, a representative of a company offering this technology was invited to inspect the County bridges. Based on the inspection, three bridges were identified as potential candidates for the using this technology, including ‘Alaalaula Bridge, Mahalawa Bridge and Koukou‘ai Bridge. Additional studies would be required to determine if the required structural strength can be achieved using this technology, as well as its compatibility with requirements for addressing other deficiencies.

5.5 Historic Bridge Program

The Surface Transportation Act of 1978 established the Historic Bridge Program, which provides for reasonable costs associated with actions to preserve, or reduce the impact of a project on the integrity of historic bridges. In particular, if as a result of a Federal-aid project, a historic bridge is no longer to be used for vehicular traffic, the cost for rehabilitating the bridge for non-vehicular use may be eligible for Federal-aid reimbursement through the Program. The amount reimbursable, however, is limited to the cost that would otherwise be incurred for demolishing the bridge. This Program may be applicable to Federal-aid bridge replacement projects in which a new bridge is constructed next to an existing historic bridge.

5.6 National Scenic Byways Program

In 1991, ISTEA established the National Scenic Byway (NSB) Program, which continues under TEA-21. The purpose of the Program is to recognize and enhance roads which

have outstanding scenic, historic, cultural, natural, recreational, and archaeological qualities and supports State scenic byways initiatives. Under the NSB Program, States can receive federal grants to plan, design and develop a Scenic Byways Program and to implement projects on highways designated as a National Scenic Byway, All-American Road or as a State Scenic Byway. The Federal share of projects funded is typically 80 percent.

The State DOT-H is in the process of developing Hawai‘i’s scenic byway program using NSB Program funding. A significant component of the program is the development of a corridor management plan for nominated National Scenic Byway or All-American Roads. The corridor management plan must include a strategy for maintaining and enhancing the intrinsic qualities supporting their designation. Inasmuch as current design standards applicable to bridge improvements along a designated highway could affect its intrinsic qualities, the corridor management plan must provide a strategy for applying those standards to protect those intrinsic qualities. This could include the development of State standards specifically applicable to the bridges in a designated highway. Those State standards would then apply to Federal-aid projects for those bridges. Hence, Federal-aid obtained through programs such as the HBRRP could be used for bridge improvements meeting new standards developed to protect their intrinsic qualities within a designated National Scenic Byway or All-American Road. The State DOT-H has indicated that they are several years away from developing Hawai‘i’s scenic byways program.

6. COMMUNITY AND AGENCY CONSULTATION

The following chronology documents the consultation process for this Preservation Plan:

1. April 2, 1998 – Site inspection of the County's bridges with the Administrator of the State Historic Preservation Division (SHPD), Department of Land and Natural Resources.

2. February 25, 1999 – Meeting with the Administrator of the SHPD to present and discuss preliminary recommendations of the Draft Preservation Plan.

3. May 19, 1999 – Copies of the Draft Historic Preservation Plan were distributed at the Maui Cultural Resources Commission for public review and comment.

4. September 6, 2000 – Public Informational Meeting in Hāna on the preparation of a Revised Draft Preservation Plan.

5. October 26, 2000 – Site visit of the County's bridges to present preliminary recommendations developed for the Revised Draft Preservation Plan. Invited were representatives from the FHWA, State DOT-H, SHPD, Maui County Planning Department, Maui Cultural Resources Commission, Hāna Advisory Committee, and Alliance for the Heritage of East Maui (AHEM).

6. December 7, 2000 – Status report and presentation of preliminary recommendations developed for the Revised Draft Preservation Plan to the Maui Cultural Resources Commission.

7. February 12, 2001 – Site visit of the County's bridges with a representative of the Fyfe Company, LLC to discuss the potential for using composite materials to rehabilitate bridges. In attendance was a representative of the Maui Cultural Resources Commission and the National Park Service.

8. June 4 and 5, 2001 – Publish and distribute the Revised Draft Preservation Plan.

9. June 19, 2001 – Public Informational Meeting in Hāna to present the Revised Draft Preservation Plan.

10. July 5 and August 9, 2001 – Presentation of the Revised Draft Preservation Plan to the Maui Cultural Resources Commission.

11. Correspondence related to the preparation of the Revised Draft Preservation Plan (May 2001) and the Final Preservation Plan are included in Appendices E and F, respectively.

12. Letter of Concurrence With Preservation Plan from State of Hawaii, Department of Land and Natural Resources, Historic Preservation Division, December 3, 2001.

RECOMMENDATIONS

6.1 Overall Recommendations

Preservation Plan recommendations for the 14 County bridges in the Hāna Highway Historic District were developed in consideration of the following:

1. Ten of the 14 County bridges are Structurally Deficient and should be addressed immediately, either by replacement, rehabilitation or temporary shoring. Keeping the bridges in service in their present condition is an immediate public safety concern and a significant tort liability risk to the County.

2. Federal-aid should be pursued to address the ten Structurally Deficient bridges for the following reasons:

   - Limited availability of County funds and long-term tort liability risk to the County if funds are used for bridge improvements that do not meet current design standards;
   - The high priority of these bridges for Federal-aid through the HBRRP and, possibly, through the Innovative Bridge Research and Construction Program;
   - Recent consideration of a Design Exception by the State DOT-H and FHWA, on a case-by-case basis, to allow a 16-foot wide (railing-to-railing) bridge deck and continued single-lane operation of bridges in the Hāna Highway Historic District. This Design Exception can preserve an important historic character-defining feature while reducing tort liability risk to the County; and
   - Design opportunities to replicate other historical character-defining features, such as railings, meeting current design standards are available.

3. In the long-term, the remaining four County bridges that are not currently rated as Structurally Deficient should be kept in service with available maintenance. Should their ratings decline in the future, other options may be available to address them. For example, as the State develops its scenic byways program, and if the program includes the Hāna Highway Historic District, then design standards specifically addressing the maintenance and enhancement of intrinsic historic and scenic qualities may be available. Federal-aid, such as through the HBRRP could then be used to meet those design standards.

6.2 Overall Design Recommendations

The overall design recommendations for addressing the County's ten Structurally Deficient bridges were developed in consideration of the following:

- The ***Detailed Preservation and Rehabilitation Guidelines*** for historic bridges (Appendix B);
- The inventory of **Historic Character-Defining Features** of the County's bridges (Table 3);
- **Design Standards** applicable to Federal-aid projects, including potential **Design Exception** for bridge deck width; and
- Input received through **Community and Agency Consultation** (Appendices D and E).

The overall design recommendations are as follows:

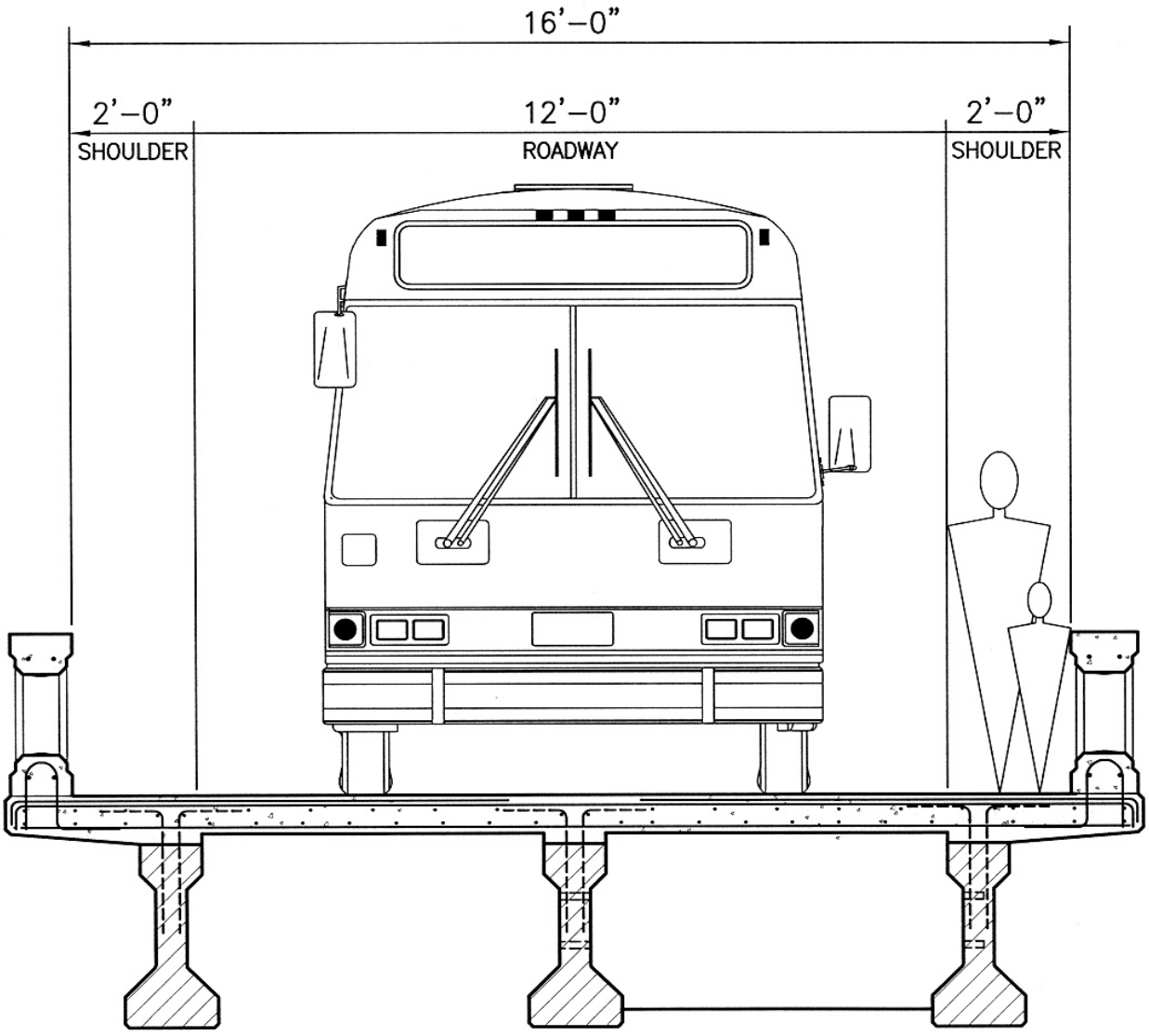
1. Replace or widen bridge decks to meet the 16-foot railing-to-railing width being considered for design exception on a case-by-case basis by the State DOT-H and FHWA (See Figure 3);

2. For bridge railings to be replaced, use a crash-tested railing design that has been cosmetically modified to resemble the existing railing. Figure 4 shows a crash-tested design that can be modified to resemble the various existing open-balustrade-type railings. For existing railings to be preserved in-place, install a freestanding steel w-beam guardrail, or other comparable protection, inside the existing railing. The minimum railing height will be 32-inches;

3. Replace bridge understructures if they are not visible in the primary view from the highway (except for Koukou'ai Bridge);

4. Preserve or reconstruct understructures to resemble the downstream side view (elevation view) of bridges for which this is the primary view from the highway;

5. Evaluate the use of composite materials for preserving the understructure of bridges for which such technology may be applicable;



WILSON OKAMOTO & ASSOCIATES, INC. ENGINEERS - PLANNERS	**PRESERVATION PLAN FOR COUNTY OF MAUI BRIDGES WITHIN THE HĀNA HIGHWAY HISTORIC DISTRICT**	FIGURE
	BRIDGE CROSS SECTION	3

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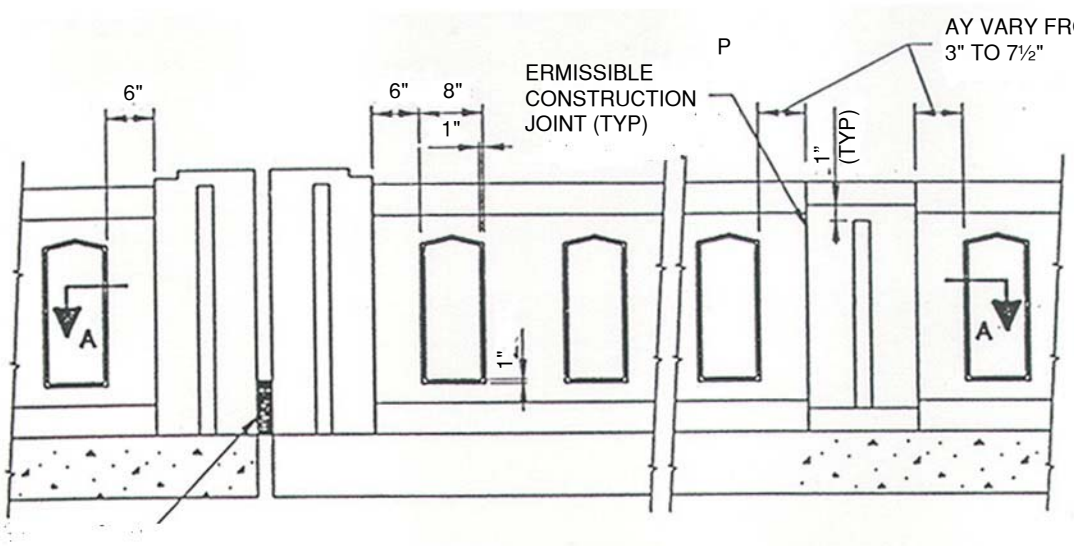

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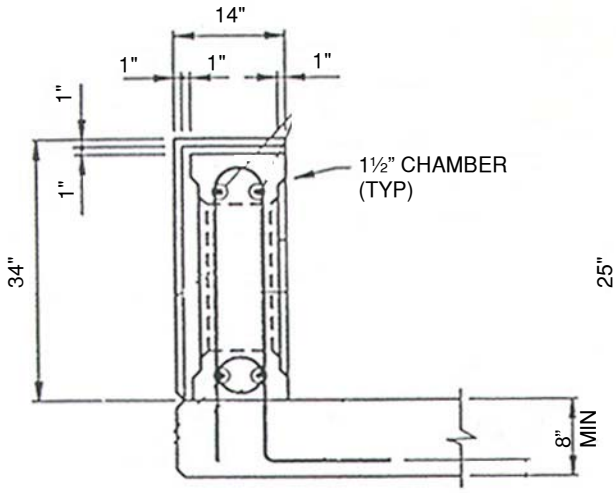
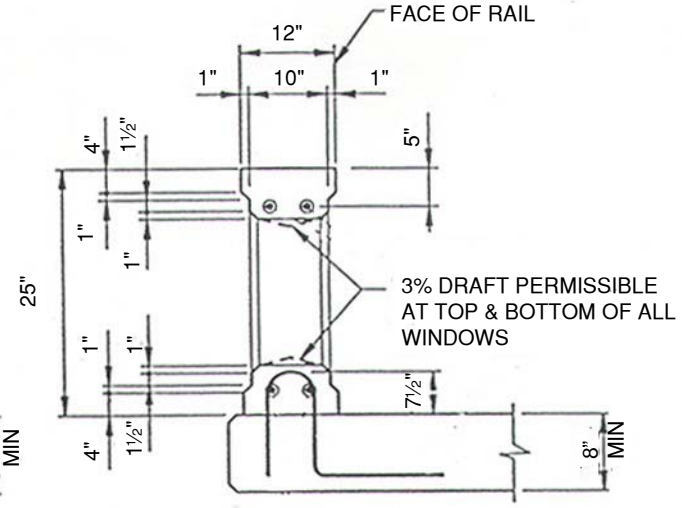


SECTION THRU POST



SECTION THRU WINDOW

WILSON OKAMOTO & ASSOCIATES, INC. ENGINEERS - PLANNERS	**PRESERVATION PLAN FOR COUNTY OF MAUI BRIDGES WITHIN THE HĀNA HIGHWAY HISTORIC DISTRICT** CRASH-TEST OPEN BALUSTRADE BRIDGE RAILING DESIGN	FIGURE 4

6. Reserve rubble from demolished CRM walls and abutments for use in re-facing replacement structures;

7. Preserve existing mid-span supports in place as non-load bearing structures unless they limit the hydraulic capacity of the bridge to pass the design storm flow;

8. Provide new rock wall guardrails along the approaches to the bridges, terminating as freestanding structures adjacent to the bridge railings. The rock wall guardrails will be a "crash-tested" design that may alternatively be constructed of lava rock with necessary reinforcements, a reinforced concrete guardrail faced with lava rock or a reinforced concrete guardrail finished to appear as lava rock. If appropriate, rubble from existing CRM guardrails will be reserved for potential use in constructing the new rock wall guardrails. The dimensions of the rock wall guardrail will be determined during design but the portion adjacent to the railings would be 32 inches high, or taller to match the height of the railing, and taper down to 27 inches high away from the bridge;

9. Provide all required signage, including those for single-lane operations;

10. Provide temporary by-pass measures, if feasible, to maintain traffic flow during construction; and

11. Prepare photographic documentation of all bridges prior to demolition or modification in accordance with the standards of the Historic American Engineering Record (HAER) and the Historic American Building Survey (HABS).

6.3 Specific Bridge Recommendations

Specific recommendations for the 14 County bridges in the Hāna Highway Historic District are summarized in the following pages. For several bridges, alternative recommendations are also provided.

These recommendations are intended to serve as the basis for design development for each bridge, recognizing that factors limiting their applicability may be determined as design development proceeds. Additional public involvement in selecting preferred alternatives, determining specific design features, considering temporary bypass

alternatives, and commenting on other specific design issues will be provided through the environmental assessment and Special Management Area permit process for each bridge.

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