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Going-to-the-Sun Road Cultural Resource Plan

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Glacier National Park

U.S. Department of the Interior . National Park Service

GOING-TO-THE-SUN ROAD CULTURAL PLAN
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GOING-TO-THE-SUN ROAD CULTURAL PLAN

I. INTRODUCTION

A. Purpose. This plan is to guide management of the cultural resources of the Going-to-the-Sun Road (GTSR) in Glacier National Park. It describes the cultural values of the road, addresses issues related to their preservation and relationship to other Park values, and establishes a broad management philosophy that will enable the National Park Service (NPS) to perpetuate the road's historic values. The plan will serve as a reference to give general direction to day-to-day operations such as snowplowing, drainage maintenance, and repair of damaged areas. It will serve as a component of future action and comprehensive plans that involve the road and will be a basis for review of NPS management proposals by other interests.

B. Need. The plan is needed to evaluate the cultural resources of the GTSR in a comprehensive manner along with other Park values related to the road. It is also needed to provide consistency of direction to the many Park activities that affect the road. Since construction began on the road in 1921, changes have occurred that have caused the NPS to modify its original form. Events such as avalanches, landslides, traffic accidents, and floods have destroyed or displaced parts of its cultural fabric. The Park's reaction to these events and the evolving standards of modern highway design, safety, and drainage requirements has in many cases also contributed to the weakening of its cultural integrity. An overall plan is needed so that the many day-to-day operations involved with the road are focused in a common direction that considers the historic values inherent in the Going-to-the-Sun Road.

C. Background

1) Agreement with State Historic Preservation Officer

A memorandum of agreement was signed by the Rocky Mountain Regional Director, NPS, the Montana State Historical Preservation Officer, and the Advisory Council on Historical Preservation during May 1987. The memorandum concerned repair to be accomplished on the Triple Arches and Loop Walls on the GTSR. Stipulations included a method of establishment of what documentation would be required for the repairs, review of plans prior to start of work, and avenues to settle disputes and amend or withdraw from the agreement.

The agreement also stipulated "the National Park Service will prepare and adopt as a basis for subsequent management decisions a Going-to-the-Sun Road Management Plan." This document comprises that plan. Its purpose is to avoid potential adverse effects of future maintenance and rehabilitation work on the road. The completed plan must be reviewed by the public and reviewed and approved by the Rocky Mountain Regional Director, NPS.

2) Federal Land Highway Program (FLHP) is managed by the Federal Highway Administration (FHWA). This program was developed in response to the Surface Transportation Act of 1982 that provided for Highway Trust Funds to be used in the improvement of Park roads. The National Park Service is responsible for transportation planning and works with the FHWA in the design and construction phases of projects to assure that Park values are retained. A Road Rehabilitation Study was done by the FHWA for Glacier National Park in 1984. This study serves as the basis for addressing engineering and maintenance needs on the GTSR. It identified over $50 million in road repair and rehabilitation needs to maintain the Park's aging road system. Some resurfacing work was done in 1984 under the FLHP program, and designs are currently being developed to solve structural problems in the Lake McDonald segment of the GTSR.

3) Transportation Plan. The Park began a planning effort in 1982 to look at the problems of crowding and congestion on the roads, needed road improvements and changes in the public transit system in the Park. Completion of the plan is expected in 1989. A primary consideration of the plan is the need for changes in the surface, retaining walls, parking areas, and other elements of the road system. Although this Going-to-the-Sun Road Cultural Plan is limited to the cultural resources of the road, it will be used as a basis for addressing cultural resources in the Park Transportation Plan. The Transportation Plan will be used to translate management philosophy into specific actions.

II. SIGNIFICANCE

A. History of Construction & Reconstruction of Going-to-the Sun Road

The first phase of Going-to-the-Sun Road construction took place between 1921-1925. During that period, under a succession of NPS administered grading contracts, primitive road was established from Apgar at the foot of Lake McDonald to near Logan Creek and from St. Mary to Dead Horse Point. Even by the criterion of that era, these road segments were of a low standard; and considerations of economy dominated both planning and

execution. "Line of least resistance" locating governed alignment, resulting in severe curvature and frequent grade changes. Grades of eight per cent or more were tolerated. Road widths fluctuated in relation to the severity of the topography traversed. In locations where relatively light excavation was required, a 20-foot standard was adopted; in other sections through difficult rock cuts, the road narrowed to only 12 feet. Provisions for drainage were meager. Surfacing was nonexistent.

In 1924, bolstered by unprecedented congressional financial support, the NPS embarked on an ambitious systematic road building program. In Glacier, increased funding meant not only that the GTSR could be pushed through to completion, but also that construction standards could be significantly upgraded. The NPS re-evaluated previous planning and design standards for the road and found both inadequate. The Bureau of Public Roads (BPR), now known as the Federal Highway Administration, was called upon to conduct a new location survey for the uncompleted and most difficult segment of the road, to cooperate with the Landscape Division of the NPS in developing plans for the "Transmountain Road Project", and to administer all future contracts for completion of that project.

In the summer of 1925 construction began on the 12-mile segment west of Logan Pass. The new BPR location, holding to a constant six percent grade throughout the western ascent, entailed much heavy excavation and resultant high construction costs. The extensive introduction of stone masonry retaining wall, guard rail, bridges, and drainage structures, design elements considered to be particularly harmonious with park aesthetic values, also contributed significantly to the cost of the project. To stay within available budget, planners held road width to a 16-foot standard throughout this difficult section, conceding that widening would have to be deferred. Only after the entire route from West Glacier to St. Mary was completed to a usable condition could attention be turned to the accomplishment of all desired improvements.

By the fall of 1928 work on the West Side Transmountain Road contract was complete. Public use of the new road segment began the following spring. In 1931 two separate contracts were let to begin construction of the segment from Logan Pass to Dead Horse Point. By October 1932 the grading work on this final link of the "Transmountain Road" was completed to a 20-foot width, 1932 BPR Forest Highway Standard. In July 1933, 12 years after the first construction project was initiated on the east shore of Lake McDonald, the entire 50-mile length of the GTSR was opened to public travel.

But, in 1933, no portion of the road was considered to be in finished condition. The most recently constructed segments--those completed between 1928 and 1933--were scheduled for extensive improvements: the widening previously mentioned, gravel surfacing, construction of additional stone masonry retaining wall and guard rail, slope stabilization, and drainage improvements. For the segments of the road constructed before 1926, complete reconstruction to the upgraded standards was planned. Ultimately, an asphalt pavement surface was planned throughout. When the first auto tourists made the Logan Pass crossing in the summer of 1933, they passed crews already at work on the first phases of a comprehensive program of improvement and reconstruction of the GTSR.

BPR and park planners found little to salvage from the pre-1926 construction. An attempt was made to follow the original alignment whenever possible, but improved standards of alignment and grade inevitably necessitated substantial deviations from the earlier line. In several instances, poorly located segments were abandoned altogether and new locations well removed from the old right-of-way were established. Reconstructed roadway in the McDonald and St. Mary Valleys was graded to a 24-foot width with imported base material and a 22-foot-wide gravel surfacing course; curvature and grade were reduced; through cuts were daylighted; drainage was improved; stone masonry bridges, retaining walls, guard rail, catch basins, and culvert headwalls were constructed; cutslopes were flattened, stabilized, and dressed; pullouts were developed; wood guard rail was installed.

By 1940 the comprehensive improvement and reconstruction planned for the GTSR was near completion, and all rehabilitated sections were surfaced with either a bituminous chip seal treatment or bituminous pavement. Only one major element of the road improvement program had not been completed: the 10-mile long western approach to Logan Pass which "badly needed reconstruction." But the onset of WWII brought to a close the first great era of park road construction projects. It was almost a decade before it was once again possible to consider major road reconstruction.

When work resumed on the Logan Pass section in the early 1950's, the extent of planned improvements had been considerably reduced. Although the need to attain greater road width was still recognized, no major excavation was contemplated. Instead, additional width was obtained by filling cutslope ditches to create a full roof section. Also, during the period, much damaged or

missing stone masonry guard rail was repaired or replaced, often to an altered design and increasingly with non-native stone, including imported Minnesota granite. In some locations where chronic guard rail damage occurred due to avalanche, the stone masonry structures were replaced by removable log guard rail. By 1957 the major rehabilitation of the Logan Pass section was considered substantially complete, and, in that year, an asphalt pavement surface was finally installed.

Since 1957 reconstruction and rehabilitation projects on GTSR have been infrequent and limited in scope. Portions of the road lost during the 1964 flood were reconstructed to an upgraded 28-foot road width standard. The West Side Tunnel was realigned, widened, and lined. Concrete cross-drains were installed at some locations in full roof sections to restore drainage capacity lost when ditches were filled in. Log guard rail of 1950's design has been supplanted by wood guard rail of wood and steel construction. Sections of failed or deteriorated stone masonry guard rail and retaining wall have been replaced both in-kind and with structures of altered design: removable wood guard rail; masonry guard rail with a concrete stem and imported stone facing; concrete retaining walls both with and without stone facing. In some locations, failed stone masonry guard rail has been replaced with isolated guard rocks, or not at all. At Logan Pass the parking area was expanded. On lower sections of the road additional turnouts were developed and log guard rails were removed. With these exceptions, the present-day road retains the basic configuration attained in the late 1950's--a configuration first broadly envisioned 30 years earlier, and essentially fulfilled.

B. National Register Nomination

The Going-to-the-Sun Road was placed on the National Register of Historic Places on June 16, 1983, at the level of state significance. The nomination said, "The significance of the Going-to-the-Sun Road is found not only in the engineering feat which claimed the tribute of Interior Secretary Ickes, but also in the road's identification with the auto tourist. During the 1930's and especially during the post World War II period, auto traffic to Glacier increased significantly. Concurrently, rail traffic to Glacier diminished in importance. The Going-to-the-Sun Road signifies not only the increase in importance of auto traffic in the park and the accessibility of more of the park to the public, but also contributed to the changing emphasis on park accommodations. During the late 1940's and early 1950's the large hotels and chalet accommodations figured less in park plans than did the creation of motor lodges such

as those at Rising Sun and Swiftcurrent. The motor lodges were to serve the new auto-traveling public. Thus, the Going-to-the-Sun Road's significance rests not only as an important engineering object, but also as it characterizes the changing nature of tourism in Glacier National Park."

C. Other Designations

The designation of National Civil Engineering Landmark was bestowed on the Going-to-the-Sun Road in July 1985. The nomination form dealt with the question of significance in the answers to items #3 thru #6, as follows:

#3 - National civil engineering historic significance of this landmark:

"First major highway through a mountainous terrain, designed by the Bureau of Public Roads, it set a precedent for the location and construction of park roads. It also established an interagency relationship between the National Park Service and the Bureau of Public Roads, in which the Bureau was made responsible for constructing and maintaining park roads."

#4 - Comparable or similar projects:

"None of this magnitude completed at that time."

#5 - Unique features or characteristics which set this proposed landmark apart from other civil engineering projects, including those in #4 above:

"One of the world's most scenic mountain roads. The two-lane surfaced road was literally carved out of the precipitous rock mountainsides for 12 miles (19.3 km) of its 50-mile (80.4 km) length. The Going-to-the Sun Road crosses the Continental Divide through Logan Pass at an elevation of 6,646 feet (2031 m). The last 9 miles (14.4 km) rises 3,000 feet (914.4 m) in elevation."

#6 - Contribution which this structure or project made toward the development of: (1) the civil engineering profession, (2) the nation or a large region thereof:

1) "It proved that roads or similar projects could be constructed directly over high mountain terrain rather than relying on limited "passes". Construction was completed with a minimum of powered equipment. A civil engineering ingenuity in overcoming physical obstacles in harmony with nature."

2) "Provided access through the park (other than foot or

horseback) to many visitors, young and old, strong and weak, as well as handicapped persons to enjoy the many splendors of the park. Established the commitment of the Park Service that national parks are for all Americans."

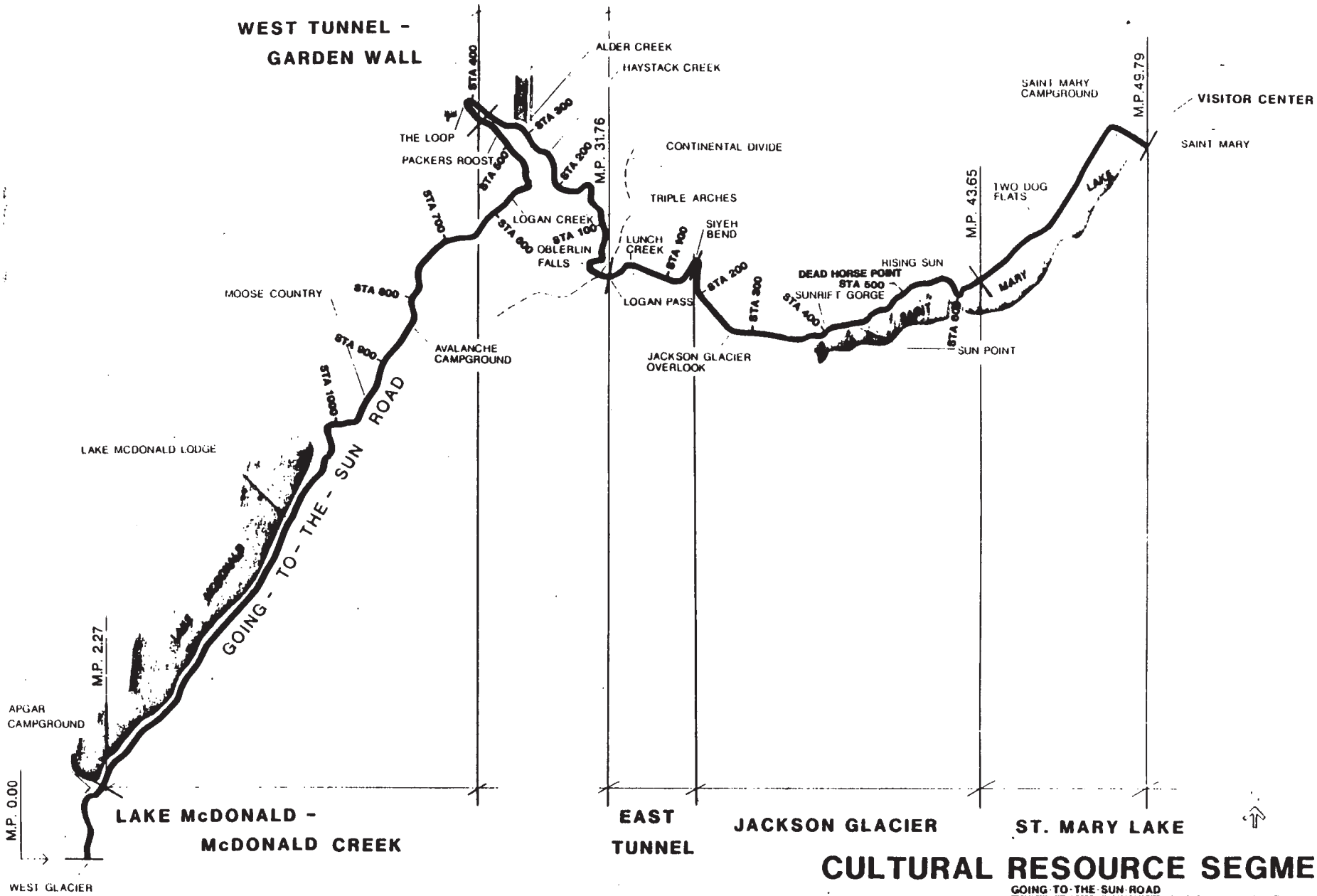
In addition to the above quoted nominations to National Registers, Historic American Engineering Record (HAER) documentation was done in November 1987. The documentation records the following on the significance of the road: Going-to-the-Sun Road has state and local significance for its engineering and role in the development of Glacier National Park. The highway's engineering features include a roadway bench carved on nearly vertical mountainsides, tunneling through sheer rock cliffs, arch bridges spanning streams, and stone guard rails. The road's importance to development of the park was expressed by the Director of the National Park Service in 1931: "It is one of the outstanding mountain roads in America. Although Glacier will always remain a trail park, construction of this one highway to its inner wonders is meeting an obligation to the great mass of people who, because of age, physical condition, or other reasons, would never have an opportunity to enjoy, close at hand, this marvelous mountain park."

D. Specific Qualities

The experience of traversing the Going-to-the-Sun Road is made unique through qualities of alignment, scenery, vegetation, masonry, historic resources, road width, precipitous exposures, broad mountainous vistas encompassing height as well as distance, and the grade of the road itself. At different points on the road, some of these qualities are more prevalent than others, but all combine to form the unique character of the Road.

This plan looks at the Going-to-the-Sun Road in five segments as shown on the Cultural Resource segment map. The unique qualities of each segment of the Road are described as follows:

1) Lake McDonald-McDonald Creek, mile 2-21. This segment of the road is thickly vegetated, passing through cool, evergreen forests. Roadside vegetation is lush, giving a feeling of enclosure within the forest that is interrupted by intermittent views of the lake and mountains. The first nine miles of the road lie along the shore of scenic Lake McDonald, and there are many roadside turnouts where the driver can view the lake or stop and walk to the lakeside. The first obvious historic resource one sees is the Lake McDonald Lodge (mile 9) complex, although this is not directly on the road. Beyond mile 9 the road parallels McDonald Creek. The valley in which the road lies narrows and quickly



CULTURAL RESOURCE SEGMENTS

GOING-TO-THE-SUN-ROAD

GLACIER NATIONAL PARK/MONTANA

UNITED STATES DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

MILES

gains steep and mountainous walls. One begins to see masonry guard wall along the road with increasing frequency. Roadside turnouts continue to occur frequently. The historic log Logan Creek Patrol Cabin is visible from the bridge at Logan Creek.

2) West Tunnel-Garden Wall, mile 21-32. Here the six per cent grade begins that continues all the way to Logan Pass, and the road curvature becomes much more severe. Its width shrinks quickly from its previous 22'-24' to 18'-22' as one begins to climb the wall of a very steep, deep valley. The road in this section is in close proximity to the adjacent rock cuts with no buffer between the road surface and the cutslope in the full roof sections. The West Side Tunnel (mile 23) is faced with stone masonry and has two masonry portals with balconies that are popular photo points for visitors. Masonry guard wall becomes very common on this section of the road. One soon passes the Loop, a very tight switchback that is associated with a small parking area. The uphill side of the road is characterized by a vertical rock wall. The downhill side of the road is characterized by historic masonry guard wall between the driver and exposures of many hundreds of feet. At several points the road passes in close proximity to waterfalls. Turnouts are common, and scenic vistas are broad and encompass height as well as distance. In one section, the rock wall has been carved to overhang the road, creating a "half-tunnel" effect.

3) East Tunnel, mile 32-35. Extending from Logan Pass to Siyeh Bend, this segment passes quickly from narrow (18'-22') precipitous roadway to a wider 22'-24' road which lies on a steep rocky side slope overlooking the upper St. Mary River Valley. Alignment straightens below Lunch Creek, and vegetation is less prevalent. Several segments of masonry guard wall are encountered in this section, as is the masonry-faced East Side Tunnel.

4) Jackson Glacier, mile 35-44. Between Siyeh Bend and Rising Sun, the road width remains at 22'-24' and the road can be driven comfortably at 45 mph. Alignment follows landforms, as it does for most of the length of the road, winding gently through a forested setting. Turnouts are common and as the road descends into the St. Mary Valley, vistas afford views that emphasize scenery and natural features, distance more than height. Jackson Glacier and various snowfields are visible throughout the visitor use season from points along this road. Much historic masonry guard wall and several masonry retaining walls are encountered in this segment, notably the walls at Dead Horse Point and the Golden Stairway, and the masonry associated with the bridge over Baring Creek. Wild Goose Island turnout, the popular postcard view of St. Mary

Lake, is located in this segment.

5) St. Mary Lake, mile 44-50. This six-mile segment is located between the Rising Sun and St. Mary developed areas. The road traverses gentle slopes, open meadows, and a relatively dry landscape. The meadow areas are generally separated by stands of aspen. Scenic views are dominated by St. Mary Lake and the mountains beyond it to the south boundary of St. Mary Valley. Historic masonry characterizes the St. Mary River Bridge. In the early mornings and late evenings it is not uncommon to see elk and bear in the meadow sections of this segment to the north.

III. ISSUES

A. Cost

Present levels of funding are not adequate to rehabilitate and maintain the GTSR to a standard that will provide long-term resource protection and serve visitor needs.

The task before Park management is to find a means by which the GTSR can be maintained in a condition that best serves visitors and appropriate to its National Historic Register status. A broad perspective understands that this is but one resource in a national system of significant historic resources that is deteriorating and that there will never be adequate funds to accomplish all that should be done. The visionary NPS and BPR architects and engineers who blended the "Transmountain Road" so gently and homogeneously to the landscape with stone arches and parapets and buttressed the road with eternal-looking stone foundations could not have foreseen a time when such labor-intensive features were more costly to maintain or replace than the modern highway structures in use today. What was expensive to build when labor was a dollar fifty a day is now of enormous cost to maintain.

It is extremely unlikely that closure of the GTSR during summer months for repair work could occur. The road's strategic importance to the regional tourism industry, the park's contractual obligations to its concessioners, and the demands of the public for use of the park all weigh overwhelmingly against such an option. Therefore, repair and/or reconstruction projects will usually be undertaken simultaneously with visitor use of the road, a condition which may add cost and certainly limits the applicability of conventional methods.

Today the GTSR still looks overall much as it did upon completion. But it is cracked and sagging and shows, upon

close inspection, the effects, not only of time and nature, but of an intervening era when technologies and economies changed and historic compatibility became secondary to the reality of cost. There has been a trend to build facilities that can be maintained mechanically rather than by hand labor. Solving present management issues on the GTSR will require innovative decisions bearing heavily on cultural and natural resources and on the level of service provided to the visitor, and these decisions will all be conditional in that they rely on uncertain future funding.

B. Historic Preservation

Efforts to preserve the road's character must be accompanied by actions to improve its infrastructure to minimize future maintenance needs.

The 1983 National Register nomination cited the road's significance for its role in park development and for the triumph of engineering and human labor that it embodied. Commensurate with this designation, it is the park's obligation to ensure that these significant qualities are preserved for the enjoyment, understanding, and appreciation of future generations.

Even though the road's engineering was a monumental accomplishment, its endurance is limited by the technology and knowledge in use at the time of its construction. Today we are able to define flaws in its construction which we are committed to correcting in such a way that appearance will not be altered while the longevity and stability of the resource will be extended. In the decades to come, as the original construction becomes increasingly vulnerable to the deterioration of age, management will be confronted with a succession of issues that will require innovative applications of new technologies to historic fabric.

Because of the historic features of the road which should not be compromised, problems that might be commonplace on other roads require extraordinary or unprecedented remedies and there will always be a degree of experimentation in finding solutions. Ways in which we solve these problems may set precedents for future solutions, but the Park must maintain an openness to new ideas and technologies that may be applied to the historic setting and still provide long-term viability for the resource.

Following is a list of some identifiable immediate and anticipated problems that are historic preservation management issues:

1) Structural Failures

The application of modern and future technologies to

structural problems on the GTSR, without compromising historic features, will have to be innovative and may at times be controversial.

a. Virtually the entire road surface and significant portions of the base are failing along the 8-mile Lake McDonald section. This portion of the GTSR was never given its intended bituminous plant mix pavement. Planning is underway with FHWA engineers to resolve problems of soils, drainage, and elevations in a way that minimizes compromises to natural resource values and to the road's historic integrity.

b. Problems that derive from the primitive construction methods of the Logan Pass section, such as inadequate drainage, poor compaction, use of soil and boulders for sub-base and fills, are becoming more evident. Voids under the driving lanes in the fill may be channeling water and causing the stone retaining wall to move outward. Unstable fill has caused sinks in the roadbed at W. Sta 219, 259, and 349 accompanied by cracking and movement in the supporting retaining walls. Probable moisture infiltration has begun to deteriorate the 60' vertical retaining wall at Dead Horse Point E. Sta 509. Stone drywall retaining supports are at some locations creeping slowly downslope or have collapsed, as at Haystack Creek, W. Sta 249.

On the Logan Pass section, where ditches were filled in during the 1950's to attain additional road width, the paved road now acts as a barrier to the up-slope watershed, and no channel intercepts seepage from adjacent soils or bedrock seams. In the spring, or with heavy rain, water at some locations runs along the pavement for hundreds of feet, confined by the guard walls, to an outlet. Examples of this condition may be found at W. Sta 34, 50-89, 140, 160, 217, 337. Cracks and pores in the pavement allow seepage into the road base, which has contributed to many of the structural problems listed above and probably is contributing to base and retaining support deterioration at locations not yet identified.

Remedial action at any of these locations could be required at any time, and responses must be planned. Reactive measures such as the work to stabilize the roadbed below Triple Arches at W. Sta 109 with an anchored concrete wall faced with stone is an example of the unique solutions that may be required to find ways of protecting the road, allowing visitor use, and preserving historic values.

2) <u>Removable Guard Rail</u>

The park has a need for an improved design for removable guard rail that will be of higher impact resistance and greater historic compatibility.

Beginning in the 1960's, and as late as 1984, sections of failed stone guard wall were replaced with wood guard rail on concrete footings. This rail does not meet FHWA crash worthiness tests and designs for new removable rail is currently being tested. In some areas the failure of the replaced wall was not due to avalanche or flood damage but was the result of inadequate structural footing or fill subsidence and slumping. Such substitutions of wood guard rail for stone structures are non-conforming with the intent to preserve, whenever possible, the road's original appearance.

Upon examining the record of repairs and re-repairs to the Logan Pass section guard wall, it is evident that there are still some isolated segments of stone wall (E. Sta 16, W. Sta 154-162, 251-257, 336, 374) which have been so repetitively impacted by snow and ice slides as to warrant consideration for replacement by removable rail.

3) Incompatible Guard Wall

Standards for stone wall and stone masonry guard wall restoration and repair must be developed that are cost-attainable, meet current safety design criteria, and perpetuate the historic character of the road.

Since the first year the road was opened, repair of damaged guard wall has been a problem. Since the early phases of construction, innumerable contracts and in-house repair/rehabilitation projects have resulted in a wide variation of guard wall styles, materials, and standards of craftsmanship.

Approximately 2850' of the total 41,260' of guard wall is built with exotic stone or of concrete faced with exotic stone including 133' of Minnesota granite surviving over four locations. Approximately 550' of Type I guard wall (without parapets) is from the post-WWII era when the NPS altered its standards for guard walls. Approximately 2400' of NPS-reconstructed wall, built by crews that were not masonry specialists, varies from compatible restoration to inferior hybridized product. Another 3000' of the Logan Pass section wall is such a mixture of materials, styles, repairs, and re-repairs that we are uncertain of its authorship. In total, some 8000' of guard wall on the GTSR is, to varying degrees, aesthetically incompatible with the original masonry either in material, design,

craftsmanship, or all three. To complicate the decisions on prioritizing restoration of this guard wall, much of this incompatible work is the most structurally sound wall on the road.

The Park must also consider the need for a wall design that would look like the original but be of greater impact resistance, utilizing steel, concrete, or other hidden reinforcement.

4) Source of Stone and Repair/Replacement

The Park must designate a source for workable stone for historic in-kind maintenance.

The masonry features on the GTSR were originally constructed of stone obtained on-site, a product of carving the road from bedrock. As the work continued beyond the road's opening to the public, designated quarries were established at W. Sta 252 and 260. The last use of those quarries, under the Morrison-Knudson contract in the 1950's, found them unsuitable, due probably to "overshooting" the limestone formation which resulted in pervasive cracking that rendered the stone unworkable. Repeated efforts by contractors to find suitable, practical sources for matching stone outside the Park were fruitless.

Limited in-kind maintenance of the original Williams and Douglas (see App. I) rubble rail is feasible without quarried stone; the required random-shaped and sized stones may be gathered from talus slopes and exposed eroded rock formations. In-kind maintenance of the later type 2a (App. I) guard rail requires worked stone of specific dimension which must be obtained by quarrying. In the section of this plan entitled "Problem Solutions" long-term masonry rehabilitation work requiring an estimated 1300 cubic yards of usable native stone is specified. A source for this stone is still not known and experience has shown that passive reliance on nature to provide material from roadside cliffs and rockslides leads to shortages of material and inferior standards.

National Park Service Management Policies (1988) state: "Materials from borrow pits or other sand and gravel sources on NPS lands...may be used only by the National Park Service in connection with functions necessary for park administration. Superintendents will only create or use new borrow pits or continue to use existing sources inside the park if it is determined, based on a written analysis, that economic factors make it totally impractical to import sand or gravel, and if

acceptable sources are identified in the park resource management plan."

The NPS borrow source policy will require that the Resource Management Plan be written to include the quarry operation, if an in-park source is proposed for use.

In-kind preservation maintenance will not be possible without sources for matching stone material. The Park must examine all aspects of the stone source problem and set realistic standards for masonry restoration, standards that can be met qualitatively and financially. Then the Park must find a workable compromise between further degradation of its cultural resource and recommencing extractive use of its natural resources.

C. Visitor Use

The Going-to-the-Sun Road is a key facility that supports a large amount of visitor use in Glacier National Park. It provides primary access for a majority of Park visitors and enables them to experience and understand a cross-section of the Park's natural and cultural resources. The Park's historic qualities, combined with the natural qualities of the vegetation, geology, and scenery in the surrounding landscape, are an integral part of the Park experience for visitors using the road. In general, visitors place a high value on the "historic scene" associated with the road, the leisurely pace of travel, and the thrill of driving in Glacier's unique mountain environment. Some 330,000 of the 1,661,000 visitors to the Park used the road in 1987. Most of this use occurred during the 6 months from mid-May to mid-November that the road was open to through traffic.

Because the Going-to-the-Sun Road is an important vehicle by which visitors are exposed to a wide cross-section of Park environments, it is a primary management concern to keep it operating and in good condition. Due to its special qualities and its importance to the visitor experience at Glacier National Park, management is reluctant to close or otherwise restrict traffic unless it is absolutely necessary. While it would be inappropriate to destroy the historic fabric of the road to increase its capacity, the Park is constantly looking for acceptable ways to improve the safety and enjoyment of the visitor experience.

D. Design

The construction of the Going-to-the-Sun Road was based on designs that were both unique in appearance and structure and significant in the Park management philosophies they

reflected.

When the road was being planned in the late 1920's, there was a strong push to accommodate automobile traffic in the Park, and this "transmountain road" was intended to further that objective. However, there was also a strong voice for preservation of the Park's scenic and wilderness qualities that often opposed this effort. The accepted design was a compromise between these two objectives and a consideration of the cost of construction. It resulted in a unique roadway that blended well with the natural environment, responded to visitor demands for scenic viewing, and satisfied the objective of accommodating traffic across the Continental Divide.

One of the components of the road design that makes it unique is the native stonework. Since the material is derived from the natural rock landscape through which the road passes, the stonework helps to blend the road into its surroundings, despite the subtle change in rock color, texture, and dimension.

The character of roadside vegetation is another important design quality of the Going-to-the-Sun Road. The overall effect is of a road in the forest with views out to the surrounding landscape rather than superimposing an unnatural road prism on the landscape. The importance of retaining this vegetative character was strongly supported by the public responses to the 1985 environmental assessment that considered improvements to the Lake McDonald segment of the Road.

The horizontal alignment of the road is also unique. Rather than using large cuts and fills to accommodate a straighter road, the designers utilized a very sinuous alignment that curves around the landforms in a way that adds interest and excitement to the driving experience.

IV. MANAGEMENT DIRECTION

A. Goals for Preservation

1) Legislation

National Park Service goals for the management of properties identified as cultural resources are footed firmly in the Federal law. The basic laws governing goal establishment are as follows:

a. NPS-28, Cultural Resource Management Guidelines. "The NPS shall faithfully preserve the cultural resources entrusted to its care and provide for their understanding, appreciation, and enjoyment through appropriate programs of research and interpretation."

This plan defines the cultural values to be preserved, researched, and interpreted on the Going-to-the-Sun Road.

b. NPS Management Policies. Park roads will be well constructed, reflect the highest principles of park design, enhance the visitor experience, and be sensitive to environmental factors. Park roads are generally not intended to provide fast and convenient transportation; they are intended to enhance the quality of a visit while providing for safe and efficient travel. Where roads are chronically used to capacity, the use of public transit or limitations on use will be considered as alternatives to road improvements. Although they may not meet current engineering standards, some existing roads are cultural and recreational resources, and their values will be preserved.

Specific road designs are subject to NPS Park Road Standards, which are adaptable to each park's unique character and resource limitations.

B. Premises to Govern Future Road Activities

1) The Park shall manage the GTSR to retain, as closely as possible, the appearance of the road as it was originally constructed from the lower end of Lake McDonald to the St. Mary entrance. It is the Park's goal to preserve the road's integrity as an example of historic American road engineering.

"Original construction" incorporates the several phases of construction and reconstruction that culminated in the "finished" road and its appurtenances during the period 1921-1939. It also includes the several significant modifications that have been made post-construction prior to its National Historic Register nomination including asphalt surfacing, improvements to both tunnels, the 1964 flood reconstruction, and other changes which the park has neither the intent nor the means to restore to original fabric. However, the following qualifications apply:

a) Alignment. The Park will endeavor to retain the existing alignment of the GTSR between the foot of Lake McDonald and the St. Mary entrance in future rehabilitation projects. Geological or deluvial events could alter that alignment. Incidental minor changes in alignment could occur where repairs are required and natural resource or structural viability concerns require an alignment shift as a last resort.

b) Width. It is the intention of the Park to maintain the GTSR at its present width. The road would not be

widened to attain more modern standards or to allow a greater traffic volume than it accommodates now. Where erosion, repair or a preventive maintenance activity, such as better drainage control, causes a reduction in driving surface on one side of the road, the Park may choose to compensate at the other side so as to keep driving surfaces no less wide than they presently are.

Incidental, site-specific widening may occur when it is unavoidable at a site, such as to allow traffic passage during repairs, to preserve historic masonry features, or to provide structural stability in unstable areas. Keeping the road open to visitor use during lengthy repairs would be an acceptable reason for temporary or limited widening at a given site. However, the Park is committed to finding alternatives other than widening to accommodate future problems of traffic volume and congestion.

2) In retaining the original appearance, it is the Park's intent to provide tomorrow's visitor with, so near as possible, the opportunity to experience the Park resource as it was experienced in that era when automotive transportation revolutionized American travel, a memorable experience at a gentle pace, offering elements of risk, exhilaration, and accomplishment, with many opportunities for roadside pauses and contemplative solitude. The GTSR's narrower winding alignment, its traverses of sheer precipices, views of water, nearness to vegetation, and raw cliff cuts are all parts of that experience.

   In the formative era when the NPS road system was being developed, the GTSR was a benchmark achievement for the visionaries who wanted roads to be a part of the experience of the Park, to blend with the terrain as almost indigenous features, while offering the traveler an exhilarating participation in the surrounding natural environment. Our goal is to retain that participant experience.

3) The Park's dedication to preserving the historic appearance of the road will be a primary consideration in all road management activities. However, the need to optimize roadway safety characteristics without damaging or destroying the historic fabric of the road will be emphasized. Specific instances of hazards or known unsafe conditions such as potential falling rocks, eroded shoulders and roadside cliff projections, will be continually remedied in ways that compliment the historic appearance of the road.

4) A programmatic Memorandum of Agreement with the State Historic Preservation Office is being developed which will satisfy the compliance requirements associated with operation and maintenance activities.

The need for this operation and maintenance capability is warranted by these considerations:

a) The maintenance season for portions of the GTSR is usually less than 22 weeks per year;

b) Most road maintenance, including asphalt repairs, stone masonry, and seal coating, is dry weather dependent;

c) Some years, particularly on the Logan Pass section, less than half of the annual work period is dry weather;

d) The majority of routine road repairs are in response to unpredictable moisture problems, snow and rock slide damage, vehicular accidents, and subsurface failures and are not predictable;

e) Repairs must be accomplished as needed, as weather allows, and simultaneous to the visitor use season.

5) To protect the road from erosion or moisture infiltration, the Park may install additional drainage features as they may be required in the future. Because erosion and slide activity occasionally alter the alpine watershed, the GTSR system of drainage facilities cannot be considered to be fixed. On the Logan Pass section, some original spillways and culverts no longer carry water. A rock slide, vegetation change, or fire above the road may divert runoff to previously unaffected road zones. Any required additional features will be made compatible in appearance with existing ditches, spillways, culverts, and gutters.

6) It is the intent of Park management to avoid the installation of unprecedented features along the GTSR in keeping with preserving historic appearance and experience. Guard walls with exposed concrete, cut-slope retaining walls, flashing traffic signals, curbed pull-outs, and pedestrian overpasses would all be such unprecedented features. Deviation from this premise could only occur where an unprecedented feature was the last resort to a structural problem or to avoid unacceptable natural resource impact. The Park would make every effort to blend such a feature to the road's historic fabric.

7) The Park will attempt to restore those segments of the GTSR that have been altered significantly from their original appearance to historic conditions where

possible. Excluded from this premise would be those major post-construction improvements (paving, etc.) listed in Premise I above. Specifically, the Park will study the feasibility of restoring stone guard rail on the Logan Pass section to those locations which originally had stone rail and which are not vulnerable to avalanche activity.

V. PROBLEM SOLUTIONS

A. Proposed Actions. The following actions should be taken as soon as possible:

1) Masonry Program

The Park will refine its in-house capability to replicate the style and craftsmanship of the original GTSR stone features by obtaining and/or training skilled personnel. A system of inspection for quality control and continuous training will be instituted that helps surmount the operational problems of focusing a seasonal, changing work force on the long-term goal of restoration.

To facilitate this capability, the Park will also develop a quarrying capability for obtaining raw native stone from the same or similar sources that supplied the original masons' materials.

2) Guard Wall Standards

The adoption of standards to guide repair and rehabilitation work on the GTSR guard wall is the first step in insuring the preservation of the road's historic character. Appendix I to this plan details the historic evolution and types of guard rail on the GTSR and illustrates the style variations. Taking account of the wide variation in existing styles, craftsmanship, and materials, standards to which future work will be done must be both precise and flexible. Table 1 outlines what we intend to do and where. It will be the task of trained field workers to implement these standards in field situations that are unique and complex.

The GTSR guard wall will be repaired/rehabilitated in stages as it fails and as funds are available. An attainable, practicable standard has been set that balances the goal of historic preservation with a realistic assessment of potential resources.

Isolated guard wall segments such as those on the McDonald Creek at McDonald Falls, Dead Horse Curve, and Baring Gorge are individually unique and are set apart here from the Logan Pass section (see App. I). They are to be repaired in-kind as required. The standards to follow are

applicable to the Logan Pass Section of the GTSR.

a) In-kind repair (repairs to replicate that which now exists)

- Segments of original guard wall, both Style 2 and 2a, which are still in approximate original condition, will be repaired in-kind. Non-historic patches and repairs in these segments would be removed and replaced to match "in-kind" the adjacent original masonry.

- That segment of guard wall (W. Sta 123.9-128.5) which is Style 2a of non-native stone, but of high aesthetic and structural quality, will be repaired in-kind.

b) Repair to an Appearance Standard (repair to replicate the appearance of original construction)

- Minor failures and breakage which occur each season to non-original segments may be repaired in-kind to prevent worsening of the patchwork nature of existing wall. Workloads permitting, it shall be the preference of the Park to rehabilitate an entire rail segment to an appearance standard, rather than perpetuate the diversity of styles in that segment.

- Where major damage or failure occurs to guard wall that is of non-original character, the Park's first priority shall be to reconstruct it to replicate the appearance of original wall. Table I identifies the zones in which replication shall be to Style 2 or 2a.

- Those segments of guard wall that are of concrete stem construction faced with non-native stone shall, as they fail, be replaced by wall constructed to an appearance standard.

- As they fail or as the workloads allow, those isolated segments of wall built of imported stone, such as the granite sections, shall be replaced to an appearance standard using native stone.

- The isolated segments of Style 1 guard wall shall be replaced with Style 2/2a to an appearance standard as they fail or as workloads allow.

- Stone wall constructed to replace existing removable rail shall be constructed to an historic appearance standard.

- In all cases replacement and/or rehabilitation of GTSR guard wall to an historic appearance standard shall

include the installation of sub-grade permanent footings where no original footing or retaining support exists.

c) Restoration (repair to restore authentic original integrity)

- For some segments we have determined that overall a significant degree of original integrity exists despite non-conforming repairs and patches. Non-conforming portions shall be removed as feasible and replaced with new masonry crafted to replicate the adjacent original rail, as outlined in Table I.

Table I shows a station-by-station designation of standards for repair and restoration which are based on field inspections and Park engineering records. These designations will guide field activity in isolated and larger repair projects so that over a long term the masonry guard wall will be replicated to approximately its original appearance. Stations are approximate and rounded to 10' increments. Precise transitions between maintenance segments are to be located in the field. Appendix I describes and illustrates the two styles of original guard rail construction. Type 2 is rubble construction with random top course jointing; 2a is boulder top course with no longitudinal joints.

Originally, the Logan Pass Section featured approximately 11,000 lineal feet of Style 2 guard wall and approximately 27,000 feet of Style 2a. At conclusion, the restoration program would comprise approximately 10,000 feet Style 2 and 27,000 Style 2a. The reduced footage is attributable to the need for removable guard wall.

The Park recognizes that in the future, a more crash-resistant masonry wall design with a reinforced concrete stem may be feasible to replace deteriorated segments. Such a design might be more economical, more durable, and/or offer greater safety. Such an innovation could be implemented on GTSR in those areas designated for rehabilitation to an appearance standard, provided that its design accommodated a stone facing that replicated the appearance of the original non-stem wall.

3) Restore Historic Features

The Park will continue or commence work on the historic guard wall according to the following priorities:

a) The Park will replace damaged sections of guard wall as they occur from slide activity, plow or traffic damage, or structural failure. This replacement will be in accordance with the restoration standards in (2) above.

b) Of the approximately 40,000 linear feet of stone wall on the GTSR (excluding bridges), about 4,300' is in poor condition (sunken or tipped) due to lack of footing or unstable road shoulder. As funds allow, these deteriorated portions will be removed, the shoulders stabilized, below-grade footings constructed, and the walls rebuilt according to the above standards.

c) The Park will consider, as funds allow, restoring the stone guard wall to areas which originally had wall and which are not vulnerable to avalanche or flooding damage. This includes the approximately 3,400 (W. Sta 169-215) which presently has removable wooden rail; 330' (W. Sta 419) which presently has intermittent guard rocks; and 285' (W. Sta 444) which is presently open shoulder. Restoration of stone wall at these locations would increase annual maintenance loads and is of lesser priority than a) and b) above. Other locations at which masonry guard wall has been removed by or because of avalanche hazard (E. Sta 141-4; W. Sta 65, 153, 343, 351) will not be restored.

d) Of the approximately 8,500 linear feet of Logan Pass section guard wall that is incompatible with original masonry styles, approximately 3,900' is structurally sound and likely to last for many years. It is of more recent construction and well footed. The goal of Park management is to restore an historic appearance. Practically, however, we would defer removal of sound existing wall for historic purposes until the higher priority items above were accomplished. Once the Logan Pass section wall is restored to its original length, we would, by priorities based on structural and aesthetic value, begin removing incompatible sections and replacing them to historic standards.

4) Plowing Operations

The Park is committed to look for improved methods and procedures of spring snow removal from the Logan Pass section to reduce or eliminate unacceptable plow-caused adverse effect to historic masonry features. Experimental changes in plowing technologies and operations will be directed toward eliminating the use of crawler-tractors below the plane of the guard wall.

5) Safety Problems

The Park will undertake the correction of the safety problems described below and others as they are identified, with appropriate review of project effects on the historic qualities of the road. The following actions are planned as a result of problems identified in the transportation planning process and in the 1984 Road Rehabilitation Planning Study:

a) Obliteration of turnouts that are poorly located and constitute a hazard to enter and exit, as at McDonald Creek (W. Sta 787).

b) Eliminate from use by the general public those turnouts on the Logan Pass section that are too small to accommodate a vehicle without presenting a hazard to moving traffic, as at W. Sta 366.

c) Removal of protruding rocks on the Logan Pass section that present hazards to drivers' visibility and/or repetitively cause property damage, as at W. Sta 12, 359, 360, 463.

d) Installation of structurally competent vehicle containment structures (guard rails and stone masonry guard rails).

e) Addition of guard rails of park-compatible design in specific areas of identified hazard.

B. Additional Needs

Further data collection, analysis, planning or design is needed in several areas prior to proceeding with corrective action. These needs were identified as a result of considerations made in the Transportation Plan and the 1984 Road Rehabilitation Planning Study. The following is a listing of those needs:

1) Design of crash-resistant guardrails. The FHWA is currently in the process of designing crash-resistant, removable guardrails for Glacier National Park. The Park is working closely with the FHWA engineers to assure that such rails are structurally adequate, maintainable, and compatible with the road's historic qualities.

2) Geologic conditions. There should be a comprehensive study of base geologic conditions along the route of the GTSR to ascertain if there are conditions that would cause roadbed or wall failure. Should such conditions be identified, designs would have to be developed to protect the road.

3) Sources for replacement stone. Research should be done to find sources for compatible stone to be used in reconstructing damaged sections of guard wall.

4) Base stability for guard wall. Geotechnical studies should be done to assess the structural capacity of base soils in all areas that have historic rock guard wall with no concrete footing. The analysis would be used as a basis for designing reinforced footings for the historic wall.

5) Wall Condition Survey. This survey should assess the structural condition of all walls and stone guard rails on the Road. It would include large-scale photogrammetric mapping of walls and stone masonry guard rails along with a detailed on-site inspection to identify, measure, and quantify subsidence, loss of footing support, tipping, bulging mortar, and stone deterioration, and any other externally visible defects. This survey along with periodic monitoring and remeasure could be used as a benchmark to identify problems, to monitor their development, to facilitate programming of funds for repairs, to effect repairs before life threatening or irreparable damage to historic structures occur, and to provide a continuing historic record of the facilities.

TABLE I

Segment Number	Place Name	Station	Original Rail Style	Repair in-kind	Appearance Std	Restoration	Consider Removable Rail	Removable. Re-store to Stone	Orig. Rail Gone; No Restoration
1	Logan Pass Section, East Side	12.1-61	2a			x			
2	Logan Pass Section, East Side	61-81	2a		x				
3	Logan Pass and Parking Lot	0	2a	x					
4	Logan Pass to Rimrock	4-41	2a		x				
5	Rimrock to Triple Arches	50-99	2a		x				
6	Triple Arches area	99-109	2			x			
7	Triple Arches to 1st Chute	109-114.6	2a		x				
8	1st Chute	114.6-115.6	2	x					
9	1st Chute to 2nd Chute	115.6-119.5	2a		x				
10	2nd Chute	119.5-120.7	2	x					
11	2nd Chute to Big Bend	120.7-145	2a	x					
12	Weeping Wall	154-156.5	2a				x		x
13	Weeping Wall	156.5-162	2				x		
14	Weeping Wall Dirt Slope	162-167.5	2a		x				
15	Weeping Wall Dirt Slope	167.5-168.5	2		x				
16	Haystack Butte South Face	168.5-205	2a					x	
17	Haystack Butte North Face	205-212.4	2a		x			x	
18	Upper Alp Chute	212.4-213.7	2		x				
19	Upper to Middle Chutes	213.7-217.5	2a		x			x	
20	Upper to Middle Chutes	217.5-217.7	2	x					
21	Middle to Lower Chutes	222.8-224	2a		x				
22	Lower Alp to Haystack Creek Pt	226-244	2a		x				
23	Haystack Creek Pt to Haystack	244-247	2		x				
24	Haystack Creek to Turnout	251-252.8	2				x		
25	Turnout to Road Camp	252.8-266.7	2			x			
26	Alder Trail to Guard Rocks	305.5-307.6	2a	x					
27	Rocks to Granite Creek	310-318.5	2a			x			
28	Granite Creek	318.5-326.9	2		x				
29	Granite Creek to West	326.9-334	2a	x					
30	BPR Chute	336-341.4	2		x		x		
31	West to Grizzly Drain	341.4-342.5	2a		x				x
32	Grizzly Drain to West	352.5-356	2a	x					x
33	Continuing West	356-357.3	2			x			
34	Continuing West	357.3-361.8	2a	x					
35	Continuing West	361.8-364.3	2a		x				
36	Bicycle Turnouts	364.3-368.8	2	x					
37	Bicycle Turnouts to West	368.8-371.7	2a			x			
38	West to Crystal Point	371.7-378.7	2		x		x		
39	Half Tunnel	378.7-385	2			x			
40	Half Tunnel to West	385-390.8	2a	x					
41	Half Tunnel to West	390.8-393.9	2	x					
42	To End of Rail above Loop	393.9-397.5	2a	x					
43	Loop Perimeter to Parking Lot	675 lin. ft.	2	x					
44	West from Loop	417.9-426	2a		x				x
45	West from Loop	426-427	2			x			
46	West from Loop	427-428.3	2a		x				
47	To Asphalt Curb	428.3-429	2	x					
48	From Curb to West	433-436.4	2a	x					
49	To Upper Tunnel Turnout	436.4-439.8	2		x				
50	Turnout West to Tunnel	439.8-442.4	2		x				
51	West from Tunnel	444-447			x				
52	West from Tunnel	465.6-466.2	2a		x				
53	West from Tunnel	466.2-417.7	2		x				
54	West from Tunnel	471.7-473.4	2a		x				

APPENDIX I, Styles of Guard Rails on Going-to-the-Sun Road

A. TYPES OF MASONRY GUARD RAIL, LOGAN PASS SECTION

"Original construction" is considered to be Type 2 guard rail (NPS Masonry and Wood Guard Rail Types, drawing P-S-2, revised 8/5/31).

Original construction on the GTSR included two sub-types of Type 2 guard rail. The initial (subcontracted) Williams and Douglas Construction Co. guard rail (about 6,000' survive of about 11,000' built) was constructed only on top of retaining wall sections and where the road traversed sheer precipices (see map). During construction, a separate masonry crew operated from each section camp, and there are subtle differences in craftsmanship and techniques in the different road construction zones. Built in 1927-1928, it was of smaller sized stone rubble construction characterized by longitudinal as well as transverse top joints (see figure 1) and is designated here Type 2.

Figure 1
Top view, Type 2 rail, showing longitudinal and transverse joints

Its painstaking craftsmanship and meticulous blend with adjacent geological features make it a distinctive feature of the road (W. Sta 99, 259, 265, 364...).

Subsequent original contractors (Colonial Bldg. Co., 1931-1933; Lawklor, 1934-1935; Yonlick, 1934-1936) built a more conventional Type 2 rail (Figure 2) with a boulder top course containing no longitudinal top joints (E. Sta 41, 53; W. Sta 5, 81, 93, 305...). We designate this style as Type 2a. Colonial and Lawlor work resulted in a continuous guard rail from the Big Drift to the end of the cliffs below the

Figure 2

Top view, Type 2a rail, showing only transverse joints

East Tunnel. The Yonlick work was mainly on the west side, filling in gaps between Williams and Douglas rail over fill zones that were thought to have stabilized to make a virtually continuous guard rail, broken only for debris dumping chutes and for known snow slide zones. Except that they used different sources for their stone, Yonlick, Colonial, and

Lawlor guard rail are essentially the same -- conventional Type 2a rail -- and will be treated as one type. Approximately 18,000' of this construction is distinguishable today on the Logan Pass section, some of it with incompatible top course and parapet repairs.

B. TYPES OF MASONRY GUARD RAIL, OTHER GTSR SECTIONS

Isolated guard rail sections at locations such as McDonald Falls, Red Rock Point, Dead Horse Bend, Sun Point, and Baring Creek, etc., are also classified as Type 2a railing (no longitudinal top course joints). These isolated segments of guard rail (totaling approximately 7,300') are distinct from that on the Logan Pass section, either for their sublime craftsmanship (McDonald Falls) or for the variant stone used (on-site quarried stone at Dead Horse and the Golden Staircase) or for both reasons.

These sections are generally footed on more stable terrain and less battered by traffic, rock and snow slides, and plow activity. They are generally in good to excellent condition and have required minimal repair since their construction. Therefore, the preservation guidelines for these isolated segments are to repair each in-kind, adapting techniques (mortars, joint configurations, etc.) as required to match the original product, and utilizing compatible stone from an appropriate Park source.

APPENDIX II - Bibliography

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National Park Service, Management Policies, 1978

National Park Service, Cultural Resource Management Guidelines, NPS-28

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