MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

APPENDIX 5.5.1.5-B

GUIDELINES FOR VEGETATION MANAGEMENT AND REMOVAL OF DELETERIOUS MATERIALS FOR THE CARMEL RIVER RIPARIAN CORRIDOR

Monterey Peninsula Water Management District

FINAL

Guidelines for Vegetation Management and Removal of Deleterious Materials
for the Carmel River Riparian Corridor

Summary

Since 1990, the Monterey Peninsula Water Management District (MPWMD) has conducted a program in the channel of the Carmel River to reduce bank erosion and remove deleterious material. Activities under this program include the removal or modification of vegetation by hand with chainsaws and loppers, modification of large wood, and the removal of undesirable materials such as tires, trash, car parts, construction debris, irrigation tubing, household goods, and other miscellaneous items. The following guidelines were developed by staff at MPWMD to maintain the quality and quantity of riparian vegetation, preserve habitat critical to sensitive species, and allow for the protection of important public and private infrastructure.

These final guidelines are intended to be part of the Regional General Permit (RGP) for maintenance and restoration activities within the Carmel River that MPWMD has applied for to the U.S. Army Corps (Corps) of Engineers. A draft set of these guidelines was circulated in January 2001 to address comments by several agencies, both public and private, on the Public Notice for the RGP. These guidelines are a refinement of the earlier set and address concerns expressed by the Carmel River Steelhead Association (CRSA), the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries).

In particular, these guidelines address the following:

1. Routine (planned) vegetation maintenance activities. These will occur on the same schedule as other activities described in the Army Corps of Engineers Regional General Permit (RGP) for the Carmel River.
2. Unplanned activities that result from changed river conditions will be handled on a case-by-case basis by consulting with respective regulatory agencies. These guidelines include a process to expedite such cases.
3. Qualified biologists will perform a habitat assessment habitat in areas proposed for work. If habitat will be negatively affected, activities may be modified or offsetting mitigation activities will be carried out.
4. All large wood will remain in the river system. Large wood posing a threat to infrastructure or bank stability may be notched at 20 to 25-foot intervals or otherwise modified to reduce the potential for bank erosion or damage to infrastructure.
5. Dense vegetation in constricted areas in the channel bottom may be removed to width of 40 feet using hand tools.

These guidelines have the following sections:

A. Development of Guidelines

MPWMD applied to the Corps in May 1999 for a RGP that will allow certain restoration and maintenance projects along the Carmel River from approximately Rivermile (RM – measured from the ocean) one to the San Clemente Dam at RM 18.6. Several comments on the District's proposed vegetation management activities after the Public Notice for the RGP was circulated in July 2000. In response, MPWMD contacted the following agencies to resolve their concerns before drafting a set of guidelines:

California Coastal Commission: MPWMD resolved this agency's concern (removal of vegetation) by modifying the project description to exclude activities within the coastal zone (i.e., from the ocean up to RM 1.5).

CALTRANS: MPWMD resolved this agency's concern (work in the vicinity of Highway 1at RM 1) by modifying the project description to exclude activities within the coastal zone (i.e., up to RM 1.5).

Other agencies commenting about vegetation management activities included:

California Department of Fish and Game: This agency was concerned about habitat loss.

National Oceanic and Atmospheric Administration Fisheries Service (formerly the National Marine Fisheries Service: This agency was concerned about potential violations of the Federal Endangered Species Act and required a detailed description of protocols and methodologies for vegetation management.

U.S. Fish and Wildlife Service: This agency required a vegetation management plan.

MPWMD circulated a draft set of guidelines in January 2001 with a response received from the

following:

Carmel River Steelhead Association (CRSA): This group was concerned that removal or alteration of vegetation and debris would reduce cover for steelhead.

MPWMD worked extensively with USFWS to develop a protocol for habitat assessment for California red-legged frog. In addition, MPWMD also proposed a protocol for assessing steelhead habitat. No comments were received on the protocol for assessing steelhead habitat.

B. Management Goals

- Establish protocols for multi-disciplinary habitat evaluation
- Carry out a comprehensive management program
- Maintain open area for passage of flow and debris
- Maintain in-stream (mid-channel) aquatic habitat features
- Maintain streambank vegetation
- Maintain in-stream large wood
- Reduce potential for damage to public and quasi-public infrastructure (roads, bridges, municipal supply wells, pipelines)
- Reduce potential for damage to private infrastructure and property from bank erosion
- Remove deleterious materials, such as trash, tires, construction debris, asphalt

C. Habitat Assessment

All areas proposed for vegetation modification and/or large wood modification will be assessed for potential impacts to the environment. The following assessment forms will be used in evaluating sites:

Exhibit 1 Vegetation Assessment for Riparian Species
Exhibit 2 A Method for Assessing Critical Habitats for Juvenile Steelhead in Coastal Streams
Exhibit 3 USFWS and MPWMD California Red-legged Frog Habitat Assessment/Carmel River

D. Large Wood Management Guidelines

1. All native wood is to remain in the riparian corridor.
2. Work in the channel bottom will normally be carried out during low flow periods.
3. Riparian and aquatic habitat will be protected to the maximum extent practicable.
4. Debris jams in overbank areas will be broken up or otherwise modified if deemed a hazard to infrastructure and/or property (note: salvaging of large wood from debris jams for habitat enhancement is normally not possible without heavy equipment). If a debris jam poses no immediate threat to bank stability or public infrastructure, no action will be taken.
5. Debris jams in the active channel will be assessed for stability. Modifications, if required, could include lowering a portion to encourage a low flow path and/or pool development. If a debris jam is large enough to destabilize a reach, MPWMD will consult with the

appropriate resource agencies to determine measures to reduce the hazard and mitigate for any potential loss of habitat.

6. Large wood in overbank areas will be cut or notched into lengths of 20 to 25 feet and left in place. Rootball sections will generally be cut so that the entire length (rootball and trunk) is between 20 and 25 feet long.
7. Where feasible, large wood in the active channel that is deemed a potential hazard will be anchored by appropriate means. Where this method is not feasible (due to flow, access, or habitat concerns), large wood will be cut or notched into lengths of 20 to 25 feet and left in place. Rootballs will be treated similarly to those located in the overbank areas.

E. Vegetation Management Guidelines

1. Work in the channel bottom will normally be carried out during low flow periods.
2. Vegetation encroaching into the active channel from streambanks (see **Exhibit 4**) and located in areas without an acceptable overland relief will be cut under the following conditions:
   a) vegetation extending more than 15 feet from the toe of the active channel toward the center of the channel will be removed;
   b) vegetation that will cause toe scour and bank collapse will be trimmed to reduce the potential for bank failure;
   c) vegetation that would subject a tree to being washed out during high flows will be trimmed to reduce the potential for washout.
3. A minimum width of 40 feet of open water (no woody vegetation) at bankfull flow is desirable. Where this conflicts with guideline 1. a), encroaching vegetation will be cut back to leave a minimum of five feet from the toe of the streambank.
3. Where short term preservation of vegetation or debris in the active channel would likely lead to destabilization of a reach, or loss of a significant amount of adjacent habitat, MPWMD will consult with the appropriate resource agencies to determine measures to maintain long-term stability.

F. Trash Removal

1. Trash such as household waste, irrigation tubing, car parts, tires, etc. will be removed during an annual cleanup of the river.
2. If trash or other deleterious material is present in debris jams, MPWMD will attempt to selectively remove the trash without destroying the integrity of the jam.

G. Infrastructure, Property, and the Endangered Species Act (ESA)

When assessing potential impacts of a proposed activity, MPWMD will give the highest priority to protection of human life. For the Carmel River, this would likely apply to a limited set of activities, such as debris and vegetation removal near bridges that are the sole access for residents and emergency personnel. However, other conditions could arise that are life-threatening along the river, but are not included here.

The second highest priority when considering an activity will be potential impacts to species

protected under the ESA (steelhead and RLF). For the Carmel River, this essentially means that activities that protect property, but that could have an adverse effect on sensitive species, must be avoided, modified, or mitigated to reduce the potential for the decline of the species.

H. Activities Outside of Normal Work Periods

The Carmel River is a flashy system that can rise several feet in just a few hours. It is subject to dynamic forces during winter that are often not predictable. Large amounts of debris have been known to cause bridge collapses and erosion by fallen trees can required several hundred thousands of dollars worth of repairs.

MPWMD proposes a streamlined process to deal with changed river conditions that are outside of the normal annual work schedule. In general, this process would apply to changed river conditions as a result of debris flows and/or trees that have fallen into the channel bottom. However, because the river environment is unpredictable, the following process may include other unforeseen activities. The following steps will be taken:

1. As soon as possible after a new condition is discovered, MPWMD will contact resource agencies (USFWS, NOAA Fisheries) and regulatory agencies (CDFG, Corps) by telephone and/or electronic mail.
2. MPWMD will supply pictures and a written description of river conditions, potential impacts to property, potential impacts to habitat and/or threatened species, and a preferred solution.
3. Action to address a problem along the river will be taken after consulting with resource agencies. MPWMD will notify all parties about an agreed upon solution and confirm what action is to be taken and when the action would occur.
4. Daytime inspections of a site for CRLF, steelhead, and redds will be performed. The activity will be documented and included in an annual report on river activities.

I. Potential Mitigation Measures

Where removal and/or modification of vegetation or debris results in the loss of habitat at a particular site, the following measures at a different location may be possible to mitigate for such impacts (please note that these mitigations measures may require permits from State or local agencies):

1. Reestablish native riparian vegetation along streambanks with cuttings and/or seedlings and irrigate as necessary for survival.
2. Install large wood.
3. Anchor large wood in place.
4. Relocate large wood from infrequent inundation zones (e.g., floodplain) to more frequent inundation zones (e.g., low flow channel).
5. Relocate large from Carmel River State Beach to upstream areas.

J. Recommendations for Future Development

1. Modify or retrofit all bridge piers and abutments that are susceptible to debris blockage. A qualified Structural Engineer, familiar with bridges across alluvial channels, should be retained to assess the risk at each bridge associated with debris jams and make recommendations concerning appropriate modifications. Impairment of fish passage should be a consideration in analyzing the risk of debris jams occurring.
2. New and replacement bridges should be designed to pass large wood (up to three feet in diameter and 80 feet long) safely.
3. Overflow areas should be constructed within the 100-year floodplain that are capable of safely passing flow and debris.
4. Strictly enforce building regulations within the 100-year floodplain and floodway, especially for flood-damaged buildings.

K. Background

The listing of the California red-legged frog (*Rana aurora draytonii*) in 1996 and steelhead (*Oncorhynchus mykiss*) in 1997 as threatened under the Federal Endangered Species Act (ESA) has drawn attention to the value that riparian vegetation and woody debris has to these species and aquatic species in general. Woody debris and vegetation can provide a significant amount of shade and cover and overhanging vegetation can provide a source of food, as well as increase the quality of habitat.

In a naturally functioning alluvial stream, rare floods, frequent events, sediment input, and vegetation dynamics help shape the course and ecology of a river. However, the lower 26 miles of the Carmel River (see attached basin map, **Figure 1**) no longer function as a "natural" system (the total length of the river is 36 miles). Since early in the 20th century, dam building, floodplain development, incision into pre-development floodplain deposits, gravel mining, river maintenance, and water extraction practices have drastically altered many of the normal processes and conditions found in a naturally functioning alluvial stream.

The effects of human intervention in the Carmel River riparian corridor intensified between the 1950's and 1970's. Property owners and government agencies increasingly turned to levee building and streambank hardening as preferred methods of dealing with floods and bank erosion. This was especially prevalent after high flow events in 1958, 1969, 1978, 1983, 1995, and 1998. By the year 2000, an estimated 35% to 40% of the streambanks in the alluvial portion had received this type of treatment. The alluvial portion extends from the lagoon near the mouth of the river to the upstream limit of urban development at Rivermile (RM) 15.5. Much of this portion of the river is tightly constrained and flanked by development ranging from farm fields, golf courses, and single-family residences to high density condominiums and a commercial shopping center.

Several sand and gravel mining businesses operated in the Carmel River between the 1920's and the 1960's, when gravel extraction became economically unviable. The last gravel extractions were made in the 1970's in the lower portion of the river to build the Crossroads Shopping Center. These operations, in tandem with routine bulldozing for "flood control" maintenance that began in the 1950's, removed gravel bars and vegetation from the center of the stream

The last major flood control channel clearing project using bulldozers occurred in the fall of 1977 in response to a massive die-off of streamside vegetation. This die-off is discussed in greater detail in other MPWMD documents, but was associated primarily with severe drought and increased groundwater pumping. Many property owners and the Monterey County Flood Control District (since renamed the Monterey County Water Resources Agency) were concerned that the large number dead trees would wash out of the banks and cause debris dams along the river. A flood in 1969 had damaged or washed away several bridges along the river. Photographs from the period depict debris build-ups in several areas, so it is possible that some of the actions in 1977 to clear the river were based on the 1969 experience.

Property owners who recalled the clearing said multiple bulldozers were used to remove the dead vegetation in the Schulte reach and near Carmel Valley Ranch. Removal of the vegetation and disturbance of the banks had the disastrous effect of exposing unconsolidated streambank material

to high flows between 1978 and 1983. The result was predictable – a severe episode of bank erosion.

Since 1990, MPWMD has conducted vegetation management using hand tools (chainsaw and loppers) as the preferred method. Most of the large gravel bars deposited in the 1978-1983 episode of erosion have been reconfigured as functional floodplains and revegetated, rather than pushed to the outside of the active channel.

Currently, vegetation dynamics play a key role in streambank stability, or lack thereof, and in changes to flow conveyance. In addition, large wood and other woody debris affects the stability of the 19 bridges across the lower portion of the river.

Riparian Corridor Background

The riparian corridor of the middle and lower Carmel River, between the Pacific Ocean at Rivermile (RM) 0.0 and San Clemente Dam at RM 18.6, begins just downstream of one of the largest shopping areas on the Monterey Peninsula (Crossroads/Barnyard) and ends in a relatively inaccessible and valuable aquatic habitat area immediately downstream of the San Clemente Dam (see attached basin map). For a more detailed set of maps, please refer to the San Francisco District Corps of Engineers Public Notice 24460S. In this portion of the river, patches of mature riparian forest are linked by thin strips of streamside vegetation and by the river bottom. Several non-native and non-riparian tree species such as eucalyptus, pine, and acacia, are present in this corridor. This area supports several sensitive aquatic species including Western pond turtles, steelhead, and California red-legged frogs. The latter two are listed as threatened and protected under the Federal ESA.

A 1986 study of the river corridor showed that about 230 acres acres of land downstream of San Clemente Dam contained native riparian vegetation (*C.M. McNeish, Effects of Production Well Pumping on Plant Stress in the Riparian Corridor of the Lower Carmel Valley, 1986.*). Floods in 1995 and 1998 widened several areas along the river and in 1996, CALTRANS sponsored a restoration project to add approximately 43 acres downstream of Highway 1. Streambank repair projects during 1995 and 1998 generally stabilized eroded banks in place, except at Rancho Cañada where an eroded area was filled in to the pre-1995 condition. Thus, the total acreage of the riparian corridor downstream of San Clemente Dam has increased since the 1986 study and may be close to 300 acres.

Approximately 1,600 parcels have been identified as having residential use and being affected either wholly or in part by the FEMA-defined floodplain (*Carmel River 100-year Flood Zone and Drainage Basin Analysis for MCWRA, Richard Ducoing, Sep. 1995*). A majority of these are located in the lower six miles, between the lagoon and Schulte Road Bridge. Approximately 420 individual parcels lie adjacent to the main stem in the lower 18.6 miles of river. In a few reaches, structures virtually overlook the river, or floodplain development has marched to the top of the riverbank, leaving little or no riparian buffer. Building practices and land use changes within the 100-year floodplain were formally regulated by the County of Monterey with the Carmel Valley floodplain ordinance in 1984. About 2.5 miles of this portion of the river is publicly owned. Much of Carmel Valley, including areas adjacent to the river, has developed into premium value real estate, second in cost only to Pebble Beach on the Monterey Peninsula.

Nineteen bridges currently span this portion of the river. Seven are publicly maintained (one by CALTRANS, five by Monterey County Public Works, one by the Monterey Peninsula Regional Parks District). The remainder are privately owned and maintained. All the bridges have supports within the 100-year floodway. Ten bridges have center piers in the active channel. Evidence of several abandoned (washed out) bridges can be seen along streambanks in the alluvial section. Replacement costs are estimated to be between $500,000 for a private golf cart bridge to $5,000,000 for a highway-class bridge.

At bridges with supports in the active channel, the minimum open length between abutments and center piers ranges from a low of about 15 feet at the south abutment of Boronda Bridge to as large as 80 feet at the Rancho San Carlos Road bridge. Cranes or other equipment capable of picking up trees and logs are frequently stationed at five of the 19 bridges during high flows. Equipment operators generally pick up debris caught on the upstream side of piers and abutments and transfer it downstream. Because of the difficulty associated with this (forceful flows, difficult access), and the type of equipment used (small cranes or backhoes), the largest pieces that can be moved are in the 20 to 25-foot range (2-4 tons). Larger pieces require specialized equipment, such as a boomcrane and hook assembly. The remaining 14 bridges either don't have center piers and are usually debris-free, or are not accessible to cranes.

The river is subject to wide variations in annual peak flows resulting in significant variations in the flow and size of woody debris, the amount of vegetation encroachment, transport of sediment, and stability of river banks. Instantaneous peak annual flows at Highway 1 have ranged from 0 (multiple years) to an estimated 16,000 cubic feet per second (cfs) in March 10, 1995. The “bankfull” flow ranges from about 1,500 cfs at San Clemente Dam to 2,200 cfs at Highway 1.

Reach Descriptions

Reaches described below are broadly classified according to flow and habitat characteristics. In extremely wet years, such as 1983 and 1998, the river can flow to the lagoon all year. In extremely dry years, such as during the 1988-91 period, summer low flows are maintained to the Narrows at RM 9.9 with releases from Los Padres Reservoir and winter flows are not high enough to make it to the lagoon.

It is generally assumed that downstream areas have a lower habitat value than upstream, except in the deDampierre reach (RM 13 to RM 14) where flow is ephemeral during dry years. From the upstream end of the lagoon at RM 0.5 to the Quail Lodge golf cart bridge at RM 5.2, flow is normally ephemeral. Flow normally ceases in late spring or early summer in the reach between the golf cart bridge and Robinson Canyon Road at RM 8.5. From the Narrows upstream, flow has been perennial since 1983, except as noted for the deDampierre reach.

Upstream end of the lagoon (RM 0.5) to Quail Lodge golf cart bridge (RM 5.20)

Property adjacent to the river includes open space and the Carmel Area Wastewater District treatment plant downstream of Highway 1, a hotel (1), golf courses (2), a large commercial shopping

center, three separate condominium complexes, a retirement home complex, and approximately 60 high-end single family residences. Several high volume municipal and private wells are located immediately adjacent to the river.

Two public and eight private bridges cross the river in this reach. With the exception of the Highway 1 bridge, none of these bridges are designed to pass the 100-year flow and several are not designed to pass debris safely. Most of the bridge supports, and in a few cases the bridge itself, have been damaged and repaired since being constructed. The following table lists the bridges in this reach.

Bridge	Owner[1]	RM	Damage in Year	Comment
Highway 1	CALTRANS	1.09	1995	Four-lane bridge washed out and rebuilt in 1995. Rebuilt bridge has several piers in active channel.
RC No. 5	Rancho Cañada	2.13	1995	Golf cart bridge washed out and rebuilt in 1995. New bridge designed for 50-yr. flood elevation with no center pier.
RC No. 4	Rancho Cañada	2.37	1995	Center pier in narrow portion of river. Abutment damage, 1995. No access for heavy equipment.
RC No. 3	Rancho Cañada	2.55	1995	Center pier in narrow portion of river. Debris build-up, 1995. No access for heavy equipment.
RC No. 2	Rancho Cañada	2.66	1995	Center pier in narrow portion of river. Debris build-up 1995. No access for heavy equipment.
RC No. 1	Rancho Cañada	2.80	1995	Center pier, but river is wide. Debris build-up in 1995. No access for heavy equipment.
Via Mallorca	Hacienda Carmel	3.24	most	Two-lane bridge. Equipment required to be staged on bridge at high flows to remove debris.
San Carlos	RSC	3.86	1995	Center supports and left abutment undermined and repaired. Additional work required after the 1998 flood to shore up left center support previously repaired in 1995. work. Debris removal equipment usually staged at high flows.
Valley Greens	MCPWD	4.82	none	Clear span w/ abutments at edge of active channel.
Quail Lodge	Quail Lodge	5.20	1969	Bridge washed out and rebuilt with clear golf car span. No equipment access.

Along nearly all this reach, the river corridor is narrow and constrained with levees and/or structural bank protection. Riparian vegetation at the top of the riverbank generally varies from zero to two tree canopies wide. Mature riparian forest areas occur in two isolated patches along the lagoon/Crossroads area between RM 0.5 and RM 2.0 and on the Rancho San Carlos property between RM 3.6 and RM 3.9.

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1. Owner or responsible agency. CALTRANS = California Department of Transportation, R C = Rancho Cañada, MCPWD = Monterey County Public Works Department, RSC = Rancho San Carlos (Santa Lucia Preserve)

Riverbank heights range from 15 to 30 feet above the river bottom, most at a slope greater than 2:1. Terrace flows (i.e., flow across the developed portion of the floodplain) generally occur at levels between the 10 and 25-year return flow. Channel substrate is primarily fine to coarse sands and gravels, although the channel bottom can develop a cobble layer when sand input is minimal. The slope of the channel is about 0.2% at Highway 1 and 0.33% in the vicinity of the Quail Lodge golf cart bridge. Flow generally ceases in late spring or early summer just upstream of this reach.

In this reach, the river acts primarily as a winter/spring migratory route for steelhead, with occasional late spring/early summer habitat for young-of-the-year steelhead. Sources of cover and shade for aquatic species consist mostly of overhanging vegetation, with some large wood from high flows in 1998 remaining in near bank areas. Several pools are located along this reach, but cobbled riffles are often short-lived as sand tends to migrate along the channel bottom and fill in riffle areas, even at flows as low as 10 cfs. Fish counts during annual rescue activities show that this reach supports the lowest number of fish per foot of any area along the river, except during drought years when smolts may be stranded in pools. However, the highest number of RLF sightings have occurred in this reach, probably due to the presence of perennial ponds at the Rancho Cañada and Quail Lodge golf courses.

Prior to 1995, most of this reach was flanked by a thin strip of mature riparian trees consisting primarily of willow species and black cottonwood, with a few other riparian trees scattered in the corridor. The open area of the channel (i.e., width between left and right bank vegetation) varied between about 45 and 80 feet wide, with most of the reach between 50 and 55 feet wide.

High flows in 1995 and 1998 eroded streambanks, stripped off streamside vegetation, and significantly widened the channel. Damage was especially severe in reaches with no overland relief outside of the active channel. The loss of mature riparian trees, particularly large cottonwoods, due to those flows was monumental. Many large trees remain at risk, should high flows return. Vegetation encroachment into the active channel, which historically has been dealt with by physical or mechanical means, is not currently an issue in this reach. On the contrary, some encroachment adjacent to unstable streambanks could be beneficial.

Vegetation encroachment into the active channel bottom is due to a combination of overhanging mature vegetation, seedling development , and gravel bar recruitment. In many years, the highly mobile sandy bottom and lack of moisture in the summer discourages seedlings from maturing. However, a combination of a wet period that allows seedlings to develop followed by dry years that don't flush seedlings out of the bottom can encourage encroachment. Rooting of willows occurs as branches from trees growing above the elevation of bank scour often overhang onto the channel bottom or are forced by flow into the channel bottom to root. Sediment is trapped in new growth and extends the bank toward the center of the channel.

During dry periods these processes can be extensive. As the channel shrinks and gravel bars develop, the potential for bank erosion, flooding, and sudden loss of mature riparian habitat due to high flows increases. Encroachment of woody vegetation can occur rapidly, so that over a five to ten year period, the capacity of the channel to safely pass debris and moderate flows (less than a 10-year return flow) can be compromised.

Quail Lodge golf cart bridge (RM 5.20) to Narrows (RM 9.9)

Bridge	Owner[2]	RM	Damage in Year	Comment
Schulte Rd.	MCPWD	6.70	Many	Center support repaired several times . Five feet of degradation since bridge was built (late 1940's). Debris at abutments and on center support common.
No Name	Unknown	7.8	1983	Bridge washed out in 1983. Left abutment remained until 1995, when it washed out.
Robinson Cyn. Rd.	MCPWD	8.46	1969	Center pier in narrow portion of river washed out after debris build-up during 1969 flood. New bridge built with clear span.

Property adjacent to the river includes farm and ranch land, a golf course, an RV park, a private elementary/junior/senior school, a Buddhist Temple, and approximately 75 single family residences. Several municipal supply and private wells are located within the riparian corridor.
Two public bridges cross the river in this reach, including the Schulte Road bridge, which has a center pier and abutments in the active portion of the channel. The southern approach to this bridge washed out during the 1958 flood and both abutments were eroded during 1983 and required subsequent repairs. The center pier cap appears to have been undermined and repaired at least three times by widening and deepening the pier cap with concrete. The channel bottom appears to have dropped four to five feet since the bridge was constructed shortly after World War II. The other public bridge in this reach at Robinson Canyon Road (RM 8.5) washed out in 1969 due to debris build-up and was subsequently rebuilt to withstand higher flows. It has a clear center span, with abutments located at the edge of the active channel. A private bridge, located at about RM 7.2, washed out in 1983 and was not rebuilt.

Along nearly all of this reach, the river corridor is somewhat wider than the downstream section, averaging between 150 and 200 feet wide at the top of the bank. Structural bank protection is used less, but is still pervasive, especially along the outside of meanders. Riverbanks range from 15 to 35 feet above the river bottom, but several areas include compound channels and side slopes. Overbank flow occurs at levels above the 25-year return flow. Channel substrate is composed of coarse gravels, cobbles, and small boulders with a liberal amount of sand still present from episodic erosion during 1998 in the Tularcitos Creek basin. The slope of the channel is about 0.33% in the vicinity of the golf cart bridge and increases to 0.4% near the Narrows.

Flow normally ceases in the summer at a point between the Quail Lodge golf cart bridge and the Robinson Canyon Road bridge. The wetted front of the river then fluctuates in response to drawdown and recharge of the aquifer in this reach. The 1.4-mile reach between Robinson Canyon Road and the Narrows has had perennial flow since 1993. This improvement is a result of lower

2. Owner or responsible agency. MCPWD = Monterey County Public Works Department

diversion rates at San Clemente Dam and changes made in the early 1990's to the pumping schedule for the lower Carmel Valley.

The width of riparian vegetation at the top of the riverbank is generally narrow, however riparian area below the top of the riverbank is generally greater than in the downstream reach. Maturing riparian forest areas occur in patches along the Valley Hills, All Saints, Schulte, Red Rock, Berwick, and Scarlett Restoration Projects. Two isolated patches of mature riparian forest exist along the Farina property and at the Cal-Am Berwick property.

In this reach, the river acts as a winter/spring migratory route and summer/fall rearing area for steelhead. The channel substrate and flow conditions appear to be suitable for spawning in portions of this reach, however, few redds have been sighted. Population surveys and fish counts during annual rescue activities show that this reach regularly supports ½ to 1 ½ fish per lineal foot. RLF have been sighted in the active channel and in pools adjacent to the river. MPWMD staff have also observed Western pond turtles (*Clemmys marmorata pallida*) in deeper pools. Sources of cover and shade for aquatic species consist primarily of overhanging vegetation, with some large wood from high flows in 1998. Channel complexity is greater than the downstream reach. There are well-developed pool/riffle sequences, with several deep pools located at rocky outcrops, along cut banks, along areas with structural protection, and in isolated mid-channel areas where vegetation has become established.

This reach has historically been the most unstable part of the river. MPWMD has completed seven river restoration projects since 1986 along 2.6 miles of this 4.7-mile reach. Nearly all of the remaining areas were repaired between 1978 and 1983. Vegetation encroachment in the channel bottom is likely to begin occurring within five years in this reach, especially in areas with perennial flow or a high water table. However, because there are several “relief” areas for debris and flow to move over and the flow capacity of the active channel is greater than in other areas, it is possible that vegetation encroachment will not be a significant issue during this period.

Narrows (RM 9.9) to San Clemente Dam (RM 18.6)

This reach of the river has both very good aquatic habitat and severe constraints to flow. Because flow has been perennial for nearly two decades, mature riparian vegetation can be seen in many areas. Property adjacent to the river includes two open space areas (Garland Park), several private equestrian centers, a private tennis ranch, a steelhead rearing facility, and approximately 200 single family residences. Several private and municipal supply wells are located within the riparian corridor. However, the municipal supply wells owned by Cal-Am are operated and used when wells further downstream cannot supply the Monterey Peninsula or when surplus flow is available in the river.

Two public and five private bridges cross the river in this reach. None of these bridges are designed to pass debris or the 100-year flow safely and have been damaged and/or washed out in the past by high flows (see following table).

Along nearly all of this reach, the river corridor is somewhat narrower than the section between Quail Lodge and the Narrows, averaging between 100 and 150 feet wide at the top of the bank in the

alluvial portion. In the alluvial section, structural bank protection is present along several sharp meanders, where the river is adjacent to Carmel Valley Road (at Garland Ranch Regional Park), and in the vicinity of bridges and confluences with tributaries. A small area of mature riparian forest exists between the "Bloody Bucket" at RM 15.5 and the Sleepy Hollow Fish Rearing facility near RM 17. Riverbanks generally range from 10 to 20 feet above the river bottom, with few areas of compound channels or slopes. Overbank flows occur at levels above the 10-year return flow.

Bridge	Owner[3]	RM	Year	Comment
Randazzo	private	10.13	1983	Gerry Paddock (partner) reported dropping 10-ton slabs of concrete in the river (and watched them disappear) to protect the bridge. 85-ft. clear span.
Don Juan	MPRPD	10.78	1969	Southern approach into Garland Park washed out in 1969 and was rebuilt. Large (4 ft.) center pier.
unnamed	MPRPD	11.5	??	A center pier, or perhaps a southern abutment, remains in the active channel at Garland Park.
unnamed	private	12.0	1983	Washed out, not rebuilt, north abutment remains in active channel.
Boronda Rd.	MCPWD	12.69	1983	Monterey County Public Works closed down the bridge at RM during high flows to complete emergency repairs to the abutments. Residents stranded on the south side of the river were helicoptered over the river. Two center piers in active channel.
Rosie's	MCPWD	14.45	1995	The south abutment nearly failed during high flows in March 1995. Bridge closed for a few days to complete repairs. Two center piers in the active channel.
Ward	Ward	14.7	1995	Northern approach washed out in 1995 and rebuilt. North abutment damaged in 1998. This bridge does not support heavy equipment access. North abutment in active channel.
Stonepine	Stonepine	15.78	1995	Washed out and rebuilt in 1995. New bridge has wider center span.
Old Carmel Dam	Cal-Am	18.27	1995	Right abutment appeared to be threatened by high flows. Collects a significant amount of debris.

Channel substrate is composed of cobbles and small to medium boulders with some sand still present in the main stem from episodic erosion during 1998 in the Tularcitos Creek basin. Upstream of the

3. Owner or responsible agency. MCPWD = Monterey County Public Works Department, MPRPD = Monterey Peninsula Regional Parks District.

alluvial portion, between Tularcitos Creek (RM 15.8) and San Clemente Dam, most of the channel is narrow and confined by bedrock outcrops. The slope of the channel is about 0.4% at the Narrows and increases to 1.0% near San Clemente Dam. Flow is perennial.

The width of riparian vegetation at the top of the riverbank is generally narrow, usually no more than one tree canopy wide. Mature riparian forest areas survive in thin strips along the edge of the river, except at Garland Park. There, an oxbow, which was cut off from the river when Carmel Valley Road was straightened in the 1950's, supports an isolated patch of about 24 acres of mature riparian forest.

In this reach, the river acts as a winter/spring migratory route, spawning area, and year-round rearing area for steelhead. Annual population surveys show that this reach regularly produces and supports one to two fish per lineal foot. This is the highest quality habitat downstream of San Clemente Dam. Few RLF have been sighted in this reach, but MPWMD staff have observed Western pond turtles in deeper pools.

Sources of cover and shade for aquatic species consist of overhanging vegetation, large cobbles and small boulders on the channel bottom, and some large wood from high flows in 1998. Channel complexity is fairly high. There are well-developed pool/riffle sequences, with several deep pools located at rocky outcrops, along cut banks, along areas with structural protection, and in isolated mid-channel areas where vegetation has become established. Portions of this reach are braided.

Between 1986 and 1990, an extended period of low flows, encroachment into the active channel bottom was significant in this reach. In many areas, no open water was present in the channel bottom in 1990 when MPWMD began a systematic clearing program. Between 1990 and 1995, vegetation was removed by hand from the active channel bottom and a 40-60 foot wide open water area was maintained. After floods in 1995 and 1998, debris was removed by hand and with heavy equipment. High flows between 1995 and 2000 have scoured seedlings and young vegetation, which resulted in MPWMD cutting back significantly on its clearing program.

In this reach, flow outside of the active channel causes significant damage to public and private infrastructure and property. In its current condition, this reach has adequate capacity to pass moderate levels of flow and debris. However, in a period of less than five years, vegetation encroachment can seriously reduce the capacity of the channel and raise the potential for damage during high flows.

Large Wood in the Carmel River

Literature on large wood (LW) shows that it is defined as greater than 10 cm in diameter and one meter in length. LW is normally considered a semi-permanent feature that is an essential component of aquatic habitat. While many sources within the literature describe LW as having low mobility, this does not apply as well in a flashy stream.

In the Carmel River, large volumes of wood can be floated out to sea during high flows. Because wood is exposed to a Mediterranean climate, even very large pieces (up to three feet in diameter and 60 feet long) can dry out and mobilize relatively easily at high flows. LW in the Carmel River may

be inundated for only short periods and can go dry for years. Thus, the mobility rate during dry periods is likely to be higher than during wet periods when wood is partly to fully submerged for extended periods. For this reason, it is likely that LW must be partially buried or anchored to the stream bottom or bank to be considered semi-permanent.

The debris load from the upper basin (above the Los Padres Dam), which is in the Ventana Wilderness, can be quite high. In 1995, a log boom at the reservoir held an estimated five acres of debris back during high flows. Debris was subsequently released during lower flow periods. In addition to the supply from the upper basin, debris from the Cachagua Creek, San Clemente Creek, and Pine Creek basins pass into San Clemente Reservoir. Unlike the Los Padres Dam spillway, which is considered "self-cleaning," debris at San Clemente Dam often blocks the 10-foot wide spillway ports and must be cut and pushed over the spillway by hand. This practice will end when the ports are modified as part of Cal-Am's proposed seismic retrofit project for this dam. It is likely that the size of large wood will increase as a result.

Essentially, all debris from 193 square miles must pass through the alluvial aquifer and under or over 18 bridges (in addition to the Old Carmel Dam). Added to this are trees washed out of unstable streambanks in the lower 15.5 miles of the river and debris from the remaining 62 square miles of the drainage basin. Preliminary results from a MPWMD survey of 200 trees in a mature riparian forest area just downstream of Rancho San Carlos Road bridge shows that about 80% of the trees adjacent to the channel are greater than 40 feet long and about 70% are more than one foot in diameter.

Managers of private bridges along the river have expressed an interest in reducing LW into eight- to ten-foot sections. The Monterey County Public Works Department has stated that log sections no greater than 25 feet can be managed with a crane. The practical weight limit for most equipment currently in use to remove debris is about two to four tons. A two-foot diameter by 25-foot long water-logged section can weigh up to two tons. Specialized tree trimming equipment with large booms may be able remove larger trees. However, this type of equipment is not widely available.

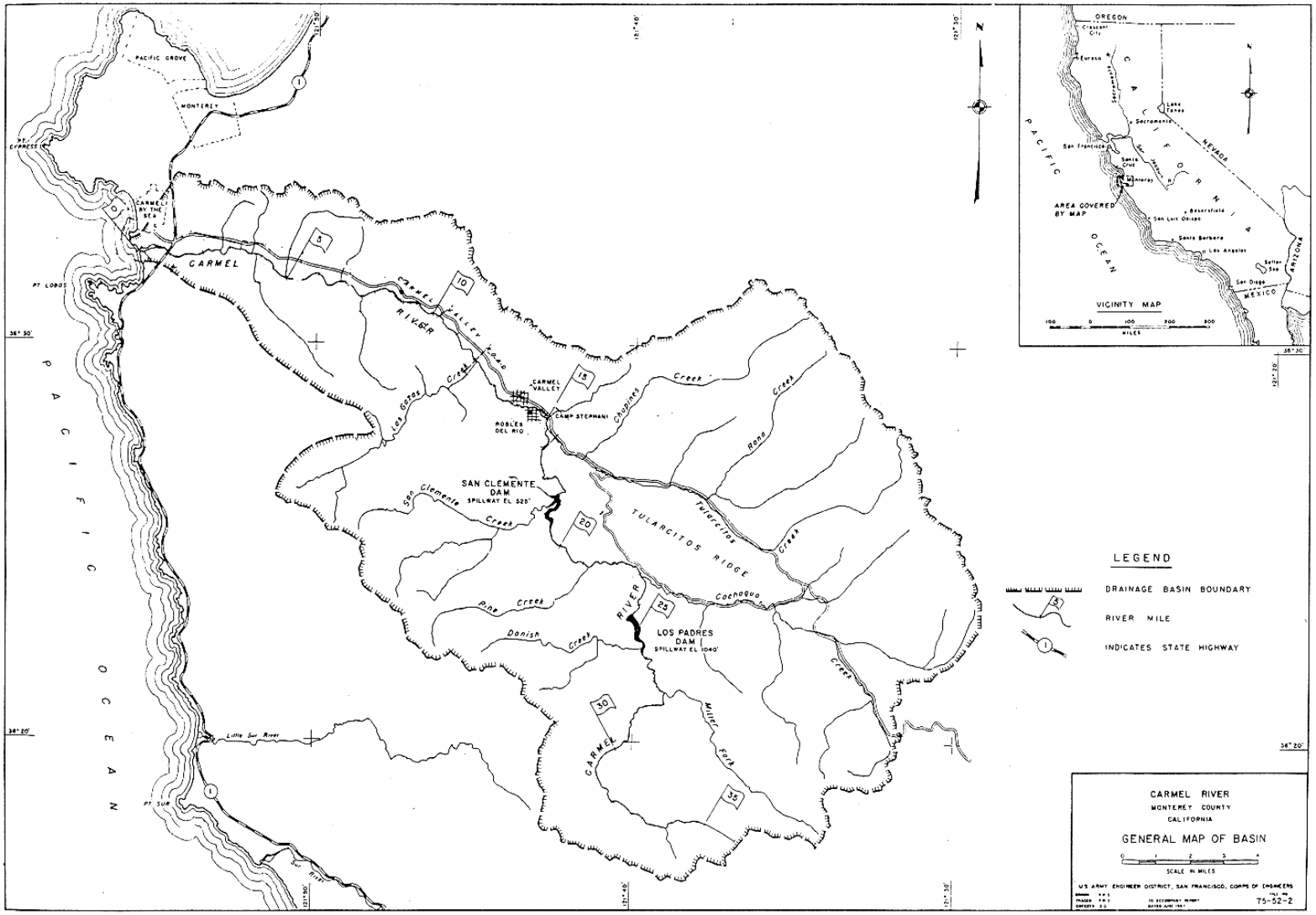

Figure 1. Carmel River Watershed