



OPPORTUNITIES for SCIENCE-BASED RESTORATION at the MERCED RIVER RANCH

This summary report describes an initial restoration design for the Merced River Ranch to benefit the aquatic and wildlife resources of the Merced River.



The Merced River Ranch Channel-floodplain Restoration Project

is an exciting opportunity to explore restoration of a highly degraded landscape in the hopes of rejuvenating the Merced River ecosystem.

processes to rejuvenate the Merced River ecosystem, and provide enhanced public access for recreation. It is based on several years of scientific studies and collaboration with state and federal agencies, and local stakeholders.

This project has the potential to improve and expand salmon habitat, restore large continuous patches of vegetation for native birds and other wildlife, reinstate natural processes to rejuvenate the Merced River ecosystem, and provide enhanced public access for recreation.

The groundwork for restoring the Dredger Tailings Reach (DTR) has been ongoing for the past 7 years. This has included studies of Merced River geomorphology, hydrology, and vegetation, and convening the Merced River Stakeholders, a group in which local residents and landowners, state and federal governmental agency staff, and other stakeholders have been able to discuss priorities and share opinions related to river management and restoration. In 2002, restoration of the DTR and removal of tailings from the floodplain was identified as a desirable restoration action, however the detailed im-

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A list of the technical reports and design documents developed to inform restoration planning at the MRR is provided on the back of this summary report.

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...was purchased by the California Department of Fish and Game (CDFG) for preservation and restoration purposes.

The Ranch is a 318-acre property on the Merced River located near the town of Snelling (Merced County) within the "Dredger Tailings Reach." Conditions at the Merced River Ranch are typical of the reach, where piles of dredger tailings cover almost 90% of the riparian area.



The Need for Restoration

Historically, the DTR of the Merced River was part of a highly dynamic, multiple-channel riparian system, with a broad floodplain and extensive floodplain forest and wetlands. The channel and floodplain habitats supported diverse, healthy populations of native fish, birds, and mammals.

Since the early 1900s, the lower Merced watershed, and the DTR in particular, has been subjected to multiple impacts including the construction of four upstream dams, water regulation for flood control and diversion, and intensive gold dredging.

These impacts have resulted in:

- disconnection of the lower river (in the Central Valley) from the upper river (in the Sierra Nevada) and exclu-

sion of native salmon and trout from their former spawning and rearing grounds;

- reduced flood flows at 20% of historical levels, and altered seasonal distribution of high and low flows, which hinder physical river processes and reduce the quantity and quality of salmon spawning areas and other channel and floodplain habitats; and
- dredger tailing "levees" which confine the river and prevent natural periodic floodplain inundation.

The current landscape is largely devoid of native vegetation, provides limited amounts of poor quality habitat for fish and wildlife, and a highly constrained river incapable of performing the natural functions necessary to support a healthy ecosystem – an area with little value for either fish and wildlife, or human uses.



Restoration of the river and its floodplain can yield multiple restoration opportunities and ecosystem benefits

- The MRR is located within the primary spawning reach of the Merced River. Restoration has been designed to benefit Chinook and steelhead salmon, two fish species of particular importance and interest. A positive response to restoration by salmonid populations may have broader impacts, including benefits to state salmonid populations, and recreational and coastal fishing communities.
- Removing dredger tailings from the floodplain will create critical rearing habitat for native fish, and in combination with revegetation, will restore native riparian forests and grasslands that are important habitat and food sources for native wildlife.
- The dredger tailings can potentially be recycled by CDFG to provide gravel for use in other restoration projects.
- The outcome of the MRR project will provide a template to guide the effective removal of dredger tailings for restoration projects elsewhere in the DTR.

Numerous plants, fish and other wildlife will benefit directly from restoration actions: (left) a rearing juvenile Chinook salmon at the MRR; (middle) an American coot feeding its young; (right) a native tili survives the harsh growing conditions at the MRR.



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RESTORATION DESIGN

Recognizing that restoration actions at the Merced River Ranch have implications for other Merced River stakeholders, restoration planners (including CDFG) solicited input from local landowners (residents and businesses), local agencies (DWR, USFWS, Merced County, Merced Irrigation District), engineers, experienced restoration practitioners, and a suite of experts in the fields of riparian ecology, botany, fisheries and avian biology, and fluvial geomorphology.

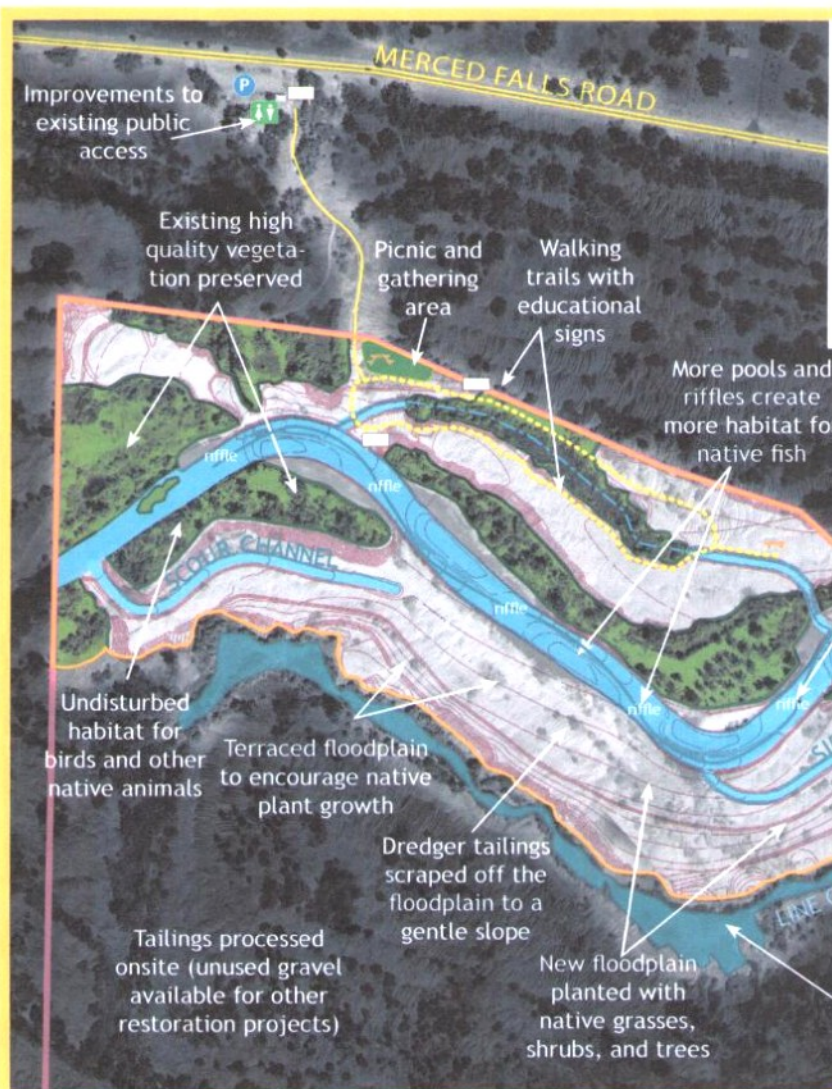
The restoration design focuses on restructuring the channel shape and adding gravel back into the channel to restore natural channel processes under the current flow conditions, while simultaneously improving vegetation conditions on the floodplain and enhancing habitat for fish and wildlife. The focus is on promoting the development of a dynamic ecosystem that is self-sustaining to the greatest extent possible, recognizing that a commitment to long-term maintenance will be required to ensure project benefits continue into the future.

The restoration strategy will capitalize on several opportunities:

- Several existing wetlands and areas of high-quality habitat will be preserved for continued use by wildlife.
- Dredger tailings excavated from the floodplain will be used onsite to reshape the channel and replenish instream gravel.
- Recognizing the long-term salmonid spawning needs, excess dredger tailings from restoration work will be stored and used as a possible long-term source of gravel for spawning gravel augmentation projects.



Draft design plans are presented to interested stakeholders during a site visit to the MRR.



Floodplain Regrading

The piles of dredger tailings at the channel's edge disconnect the river from its floodplain, thereby creating conditions inhospitable for the establishment of native plants, and for seasonal native fish rearing. Excavating dredger tailings to lower the floodplain elevation will:

- hydrologically reconnect the channel and floodplain to encourage native plant growth, and provide seasonal off-channel rearing habitat for juvenile salmon;
- contain the 100-year flood event; and
- replace lost habitat elements to increase habitat diversity for fish and wildlife.

Channel Rescaling

Currently, the river cannot perform many of the functions expected of a natural, "healthy" river, because the river channel is too big for the regulated flows released from upstream reservoirs. Rescaling the existing channel to match current flow conditions and convey a bankfull flow of 1,400-2,500 cfs aims to restore natural river functions and result in improved habitat for native fish and other aquatic species. Channel rescaling has been designed for potential future changes in flow regime, and, in combination with floodplain grading and revegetation, should be of long-term benefit to the river ecosystem.

Getting good use out of dredger tailings

Several million cubic yards of dredger tailings sit in piles on the banks of the Merced River making the land unfriendly to plants and unusable for agriculture or other land uses.

This project will "recycle" the dredger tailings and put them to use.

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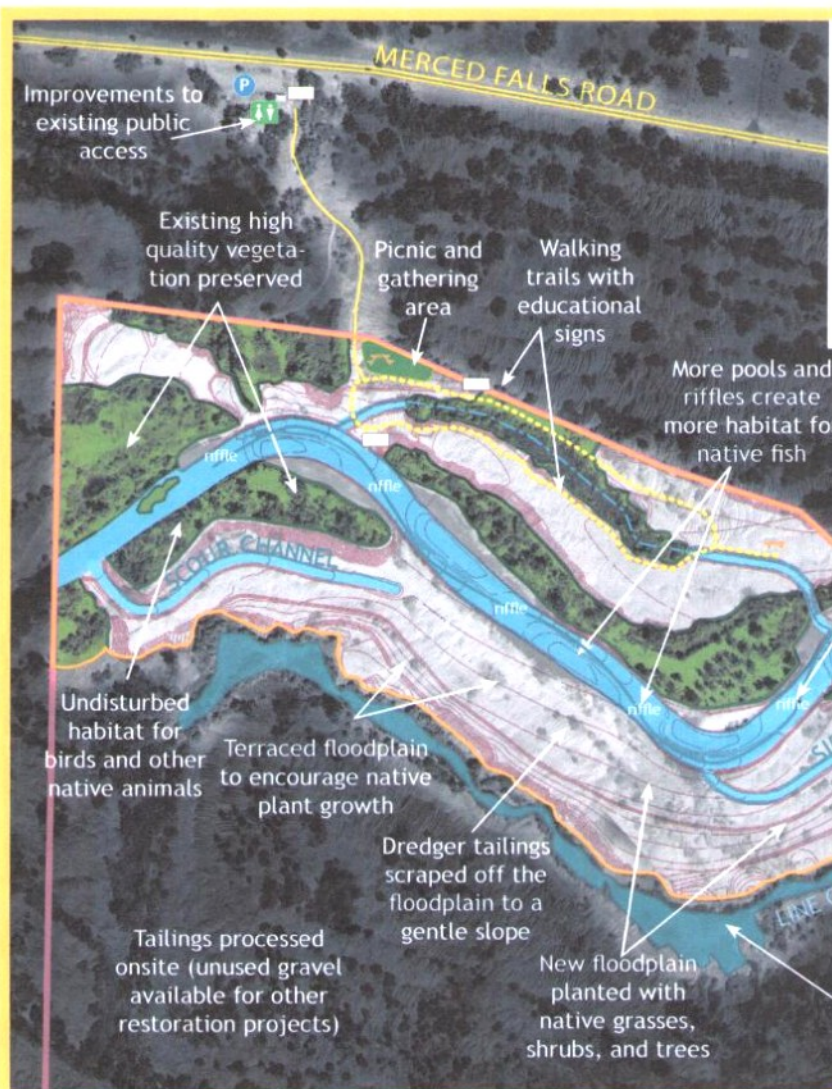
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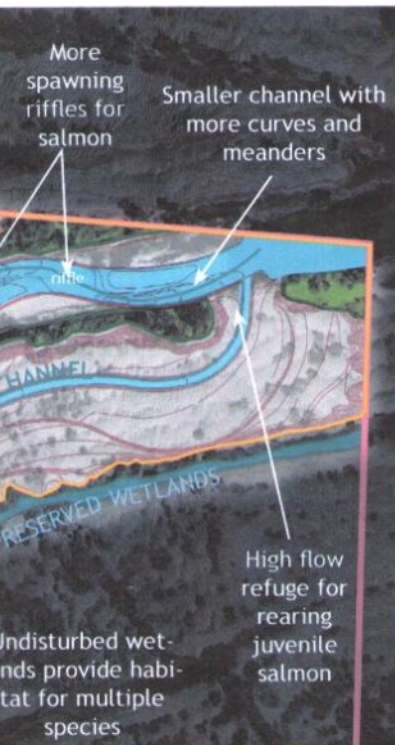
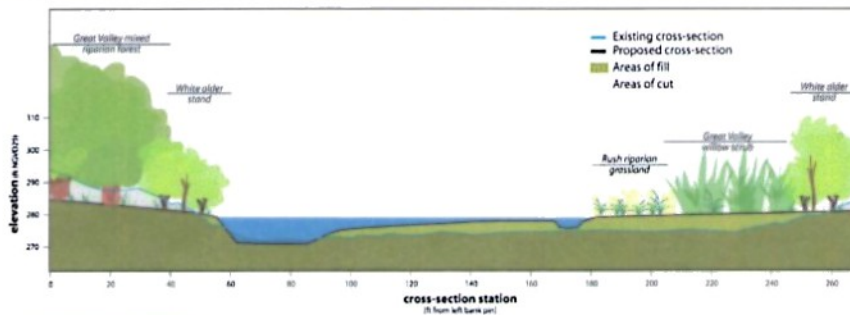
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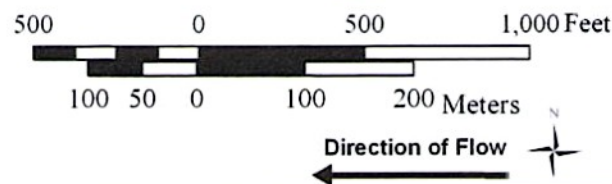
envisioning the final product

sample cross-section of the new channel and floodplain showing the gentle slope of the banks and representative vegetation.



LEGEND

- MRR property boundaries
- Restoration boundaries
- Vegetation preserved during implementation
- Restored areas
- Main channel
- Side/scour channel
- Side/scour channel through existing wetland
- Preserved wetlands
- Road
- Walking trail (handicap accessible)
- Walking trail (not handicap accessible)
- P Public parking
- Public restrooms
- Interpretive signs
- Bench
- Picnic area



In a nutshell...

- Scale down the channel to “fit” current flows.
- Reconstruct the floodplain to allow periodic flooding and encourage native plant growth.
- Add gravel to the channel to improve natural channel formation.
- Plant native tree, shrub and grass species.
- Preserve existing areas of high quality habitat.
- Improve and expand public access.
- Recycle unusable dredger piles to provide gravel for rescaling the channel, and to stockpile for use in other restoration and salmon enhancement projects.

Preservation

of existing vegetation and exist at the MRR. These valuable habitats will be preserved design and will provide: habitat while the newly planted shrubs and grasses establish; and cuttings for revegetation use. Preserved vegetation will be expanded by the revegetation will accelerate the process large, contiguous areas of native wildlife. Additionally, revegetation will continue to protect oasis during restoration.

It concluded in November 2006 revegetation techniques and made in optimizing plant survival restoration, including: on close to groundwater; east two years; on plant sizes at planting; and control.

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Revegetation

The tailings piles are nearly devoid of vegetation. Following floodplain regrading, native grasses, shrubs and trees (matched to the physical conditions of the post-project site) will be planted and irrigated to:

1. jump start natural revegetation processes;
2. restore the benefits of vegetation, such as habitat structure, nutrient cycling, soil development, stream shading, and large woody debris supply to the stream channel;
3. minimize establishment of non-native invasive plant species;
4. mitigate for disturbed wetlands and elderberry shrubs; and
5. refine revegetation techniques suitable for application elsewhere in the DTR.

A design firmly rooted in science

This Oregon ash has grown over 3 feet in one year, demonstrating the effects of two years of irrigation and weed control.



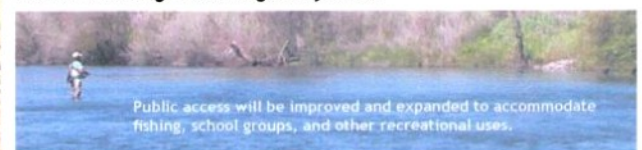
Coarse Sediment Augmentation

The series of upstream dams blocks any supply of gravel to the DTR. The only source, currently, is periodic augmentation by CDFG at select riffles immediately downstream of Crocker-Huffman Dam to benefit spawning salmon. Any transported gravel is trapped by large, deep pools (resulting from gold dredging and subsequent changes to the river) reducing the amount of suitable fish habitat downstream.

When the channel is restored, these large holes will be filled with gravel suitable for salmon spawning. In addition, gravel will be added periodically from upstream so that, over time, gravel transport continuity is re-established. This will provide the river with material to function in ways similar to that of an unimpacted, naturally dynamic river capable of developing and supporting habitats preferred by native aquatic and terrestrial species.

Public Access

This project will capitalize on existing public access on the north side of the property (Cuneo Fishing Access), and provide improvements to existing parking and restroom facilities and the addition of picnic areas and walking trails. Interpretive signs will be added along the trails to promote public awareness of site history, the restoration process, and local plants and animals, including information on salmon life stages and migratory birds.



Summarizing the changes



- Channel too wide for current flows on the Merced River
- River unable to overtop its banks and inundate the floodplain
- Limited quantity and quality of spawning and rearing habitat for native salmon and trout
- Large "holes" trap gravel and disrupt sediment transport and rejuvenation of downstream habitat
- Sparse vegetation
- Limited areas of quality habitat for wildlife



- Channel rescaled to match current flows on the Merced River
- Periodic overtopping of banks and inundation of adjacent floodplain
- Increased quantity and quality spawning and rearing habitat for native salmon and trout
- Long-term plan in place to ensure periodic replenishment of gravels
- Large scale replanting of native grasses, shrubs and trees
- Increased quality areas of habitat for wildlife
- Existing public access improved and expanded

Monitoring and Evaluation

A rigorous monitoring plan has been devised to evaluate the performance of restoration actions, provide information useful to the future management of the site, and maximize the generation of data useful to future restoration projects in the region.

What next?

The future of restoration at the MRR is contingent upon completing and obtaining all required environmental compliance documents and permits and securing adequate funding for the phased implementation of the project.

Implementing this project will not only yield significant ecosystem benefits but, through monitoring and evaluation, will provide restoration practitioners with valuable lessons and experiences to apply to restoration projects elsewhere on the Merced River and in the Central Valley.

*There's still a lot left to do!
To find out how you can
get involved, contact:*

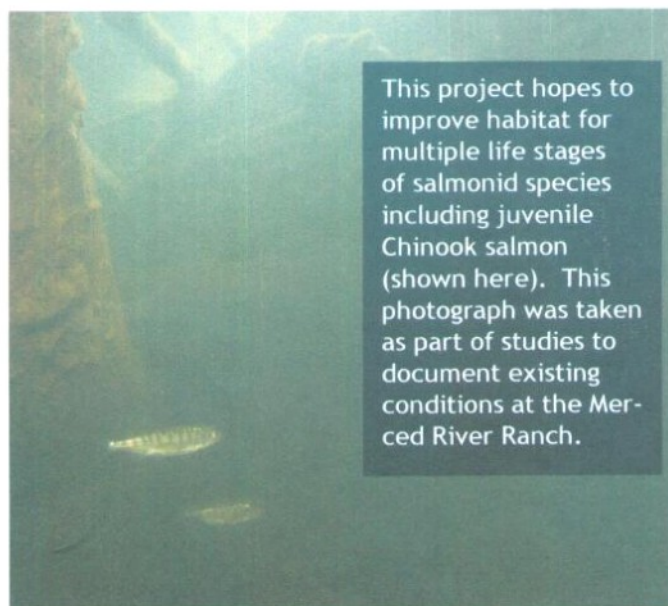
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Merced
River
Ranch

500 0 500 1,000
Meters

Direction of Flow

With an estimated 4,800 acres of floodplain impacted by dredger tailings in the DTR, the outcomes of the MRR restoration project can provide significant guidance to future restoration and tailing-removal efforts in the reach.



This project hopes to improve habitat for multiple life stages of salmonid species including juvenile Chinook salmon (shown here). This photograph was taken as part of studies to document existing conditions at the Merced River Ranch.

The Foundation

The following technical reports and construction schematics have

resulted from the studies and modeling conducted at the MRR and throughout the DTR, and provide the foundation for the science-based restoration design presented in this summary report:

- 2004. Channel and floodplain surveys of the Merced River Dredger Tailings Reach.
- 2004. Sediment transport model of the Merced River Dredger Tailings Reach.
- 2004. Hydraulic model of the Merced River Dredger Tailings Reach.
- 2004. Volume and texture analysis of the of the Merced River Dredger Tailings.
- 2004. Mercury assessment of the Merced River Ranch.
- 2005. Conceptual restoration design for the Merced River Ranch.
- 2006. Baseline monitoring of the Merced River Dredger Tailings Reach.
- 2006. Merced River Ranch Channel-floodplain Restoration: Design Rationale
- 2006. Merced River Ranch Channel-floodplain Restoration: 75% design drawings and specifications.
- 2006. Merced River Ranch Channel-floodplain Restoration: Post-implementation monitoring plan.
- 2006. Merced River Ranch Channel-floodplain Restoration: Implementation plan and researched cost estimate.
- 2006. Suite of environmental documentation: Wetlands delineation, cultural resources survey, and valley elderberry longhorn beetle survey.
- 2006. Merced River Ranch revegetation experiment.
- 2006. Groundwater monitoring and evaluation of the Merced River Ranch.

For more information and full report text, go to merced.stillwatersci.com.

This research was funded by a CALFED Ecosystem Restoration Program grant to Stillwater Sciences in collaboration with the California Department of Fish and Game.

To get involved, or for other inquiries, contact:
Tim Heyne (CDFG) (209) 853-2535

Prepared by



Stillwater Sciences

November 2006

Additional information on this project is available for download at:

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- disconnection of the lower river (in the Central Valley) from the upper river (in the Sierra Nevada) and exclu-

sion of native salmon and trout from their former spawning and rearing grounds;

- reduced flood flows at 20% of historical levels, and altered seasonal distribution of high and low flows, which hinder physical river processes and reduce the quantity and quality of salmon spawning areas and other channel and floodplain habitats; and
- dredger tailing "levees" which confine the river and prevent natural periodic floodplain inundation.

The current landscape is largely devoid of native vegetation, provides limited amounts of poor quality habitat for fish and wildlife, and a highly constrained river incapable of performing the natural functions necessary to support a healthy ecosystem – an area with little value for either fish and wildlife, or human uses.



Restoration of the river and its floodplain can yield multiple restoration opportunities and ecosystem benefits

- The MRR is located within the primary spawning reach of the Merced River. Restoration has been designed to benefit Chinook and steelhead salmon, two fish species of particular importance and interest. A positive response to restoration by salmonid populations may have broader impacts, including benefits to state salmonid populations, and recreational and coastal fishing communities.
- Removing dredger tailings from the floodplain will create critical rearing habitat for native fish, and in combination with revegetation, will restore native riparian forests and grasslands that are important habitat and food sources for native wildlife.
- The dredger tailings can potentially be recycled by CDFG to provide gravel for use in other restoration projects.
- The outcome of the MRR project will provide a template to guide the effective removal of dredger tailings for restoration projects elsewhere in the DTR.

Numerous plants, fish and other wildlife will benefit directly from restoration actions: (left) a rearing juvenile Chinook salmon at the MRR; (middle) an American coot feeding its young; (right) a native tili survives the harsh growing conditions at the MRR.

RESTORATION DESIGN

Recognizing that restoration actions at the Merced River Ranch have implications for other Merced River stakeholders, restoration planners (including CDFG) solicited input from local landowners (residents and businesses), local agencies (DWR, USFWS, Merced County, Merced Irrigation District), engineers, experienced restoration practitioners, and a suite of experts in the fields of riparian ecology, botany, fisheries and avian biology, and fluvial geomorphology.

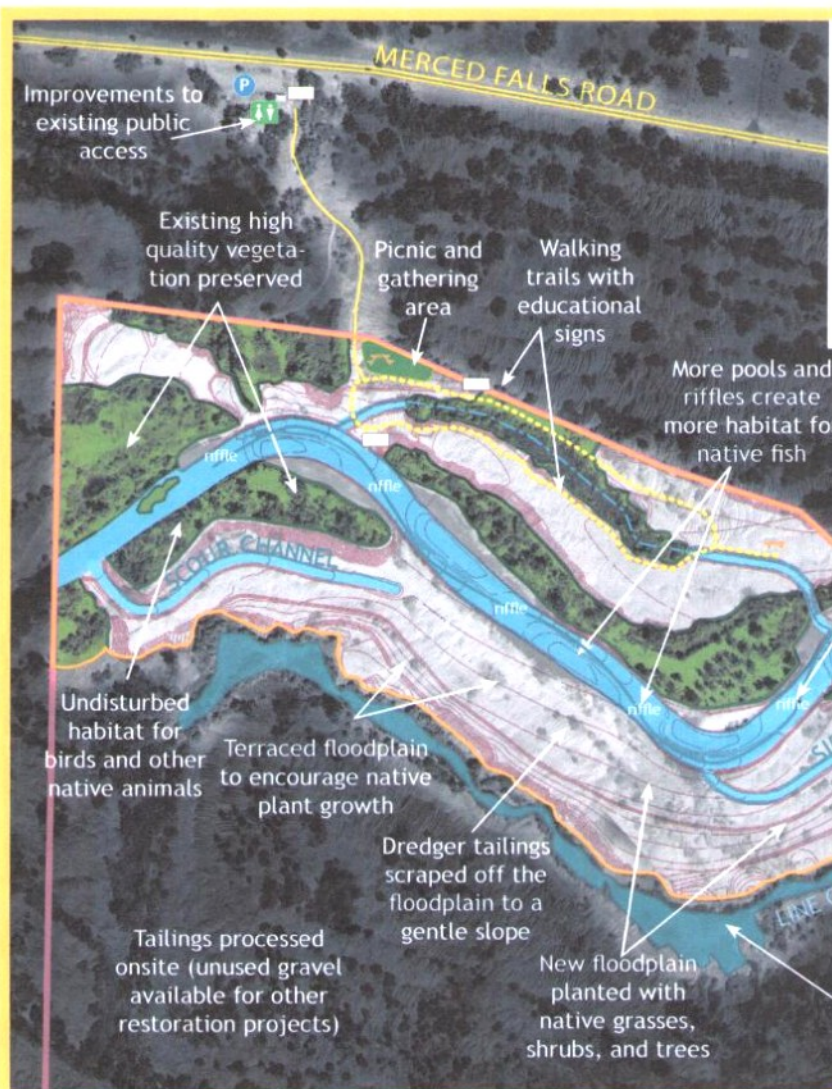
The restoration design focuses on restructuring the channel shape and adding gravel back into the channel to restore natural channel processes under the current flow conditions, while simultaneously improving vegetation conditions on the floodplain and enhancing habitat for fish and wildlife. The focus is on promoting the development of a dynamic ecosystem that is self-sustaining to the greatest extent possible, recognizing that a commitment to long-term maintenance will be required to ensure project benefits continue into the future.

The restoration strategy will capitalize on several opportunities:

- Several existing wetlands and areas of high-quality habitat will be preserved for continued use by wildlife.
- Dredger tailings excavated from the floodplain will be used onsite to reshape the channel and replenish instream gravel.
- Recognizing the long-term salmonid spawning needs, excess dredger tailings from restoration work will be stored and used as a possible long-term source of gravel for spawning gravel augmentation projects.



Draft design plans are presented to interested stakeholders during a site visit to the MRR.



Floodplain Regrading

The piles of dredger tailings at the channel's edge disconnect the river from its floodplain, thereby creating conditions inhospitable for the establishment of native plants, and for seasonal native fish rearing. Excavating dredger tailings to lower the floodplain elevation will:

- hydrologically reconnect the channel and floodplain to encourage native plant growth, and provide seasonal off-channel rearing habitat for juvenile salmon;
- contain the 100-year flood event; and
- replace lost habitat elements to increase habitat diversity for fish and wildlife.

Channel Rescaling

Currently, the river cannot perform many of the functions expected of a natural, "healthy" river, because the river channel is too big for the regulated flows released from upstream reservoirs. Rescaling the existing channel to match current flow conditions and convey a bankfull flow of 1,400-2,500 cfs aims to restore natural river functions and result in improved habitat for native fish and other aquatic species. Channel rescaling has been designed for potential future changes in flow regime, and, in combination with floodplain grading and revegetation, should be of long-term benefit to the river ecosystem.

Getting good use out of dredger tailings

Several million cubic yards of dredger tailings sit in piles on the banks of the Merced River making the land unfriendly to plants and unusable for agriculture or other land uses.

This project will "recycle" the dredger tailings and put them to use.

- Dredger tailings scraped off the floodplain during the grading process will be used onsite to reshape the channel: there is no need to import material for the project.
- The excess dredger tailings will be sorted into material that is the right size for use by spawning salmon, and periodically added to the channel to encourage spawning at the site.
- Excess, sorted dredger tailings will be stored and used as a possible long-term source of gravel for spawning gravel augmentation projects.



This patch of lush vegetation was likely untouched by dredging and will be preserved as part of this project.

Large arable floodplain under the trees. 1. cruciferous trees. 2. seeds. The pre-hatched effort of development of habitat preservation provide a

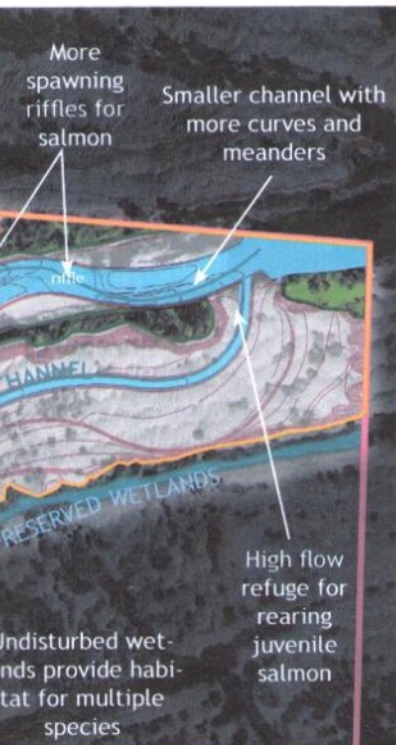
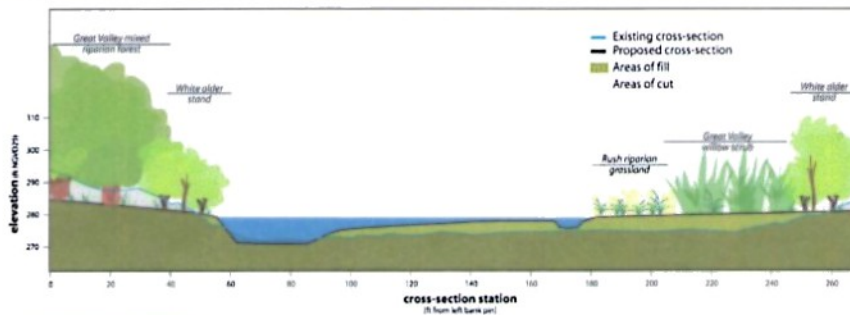
A three year experiment investigated various recommendations used and growth following

- Plant at elevation
- Irrigate for a
- Ensure minimum
- Provide weed

Utilizing the findings the many ways this strong scientific four

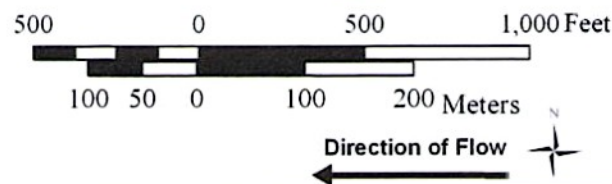
envisioning the final product

sample cross-section of the new channel and floodplain showing the gentle slope of the banks and representative vegetation.



LEGEND

- MRR property boundaries
- Restoration boundaries
- Vegetation preserved during implementation
- Restored areas
- Main channel
- Side/scour channel
- - - Side/scour channel through existing wetland
- Preserved wetlands
- Road
- Walking trail (handicap accessible)
- - - Walking trail (not handicap accessible)
- P Public parking
- P Public restrooms
- Interpretive signs
- Bench
- Picnic area



In a nutshell...

- Scale down the channel to “fit” current flows.
- Reconstruct the floodplain to allow periodic flooding and encourage native plant growth.
- Add gravel to the channel to improve natural channel formation.
- Plant native tree, shrub and grass species.
- Preserve existing areas of high quality habitat.
- Improve and expand public access.
- Recycle unusable dredger piles to provide gravel for rescaling the channel, and to stockpile for use in other restoration and salmon enhancement projects.

Preservation

of existing vegetation and exist at the MRR. These valuable habitats will be preserved design and will provide: habitat while the newly planted shrubs and grasses establish; and cuttings for revegetation use. Preserved vegetation will be expanded by the revegetation will accelerate the process large, contiguous areas of native wildlife. Additionally, revegetation will continue to protect oasis during restoration.

It concluded in November 2006 revegetation techniques and made in optimizing plant survival restoration, including: locations close to groundwater; least two years; plant sizes at planting; and control.

From this experiment is one of restoration design was based on a tion.

Revegetation

The tailings piles are nearly devoid of vegetation. Following floodplain regrading, native grasses, shrubs and trees (matched to the physical conditions of the post-project site) will be planted and irrigated to:

1. jump start natural revegetation processes;
2. restore the benefits of vegetation, such as habitat structure, nutrient cycling, soil development, stream shading, and large woody debris supply to the stream channel;
3. minimize establishment of non-native invasive plant species;
4. mitigate for disturbed wetlands and elderberry shrubs; and
5. refine revegetation techniques suitable for application elsewhere in the DTR.

A design firmly rooted in science

This Oregon ash has grown over 3 feet in one year, demonstrating the effects of two years of irrigation and weed control.



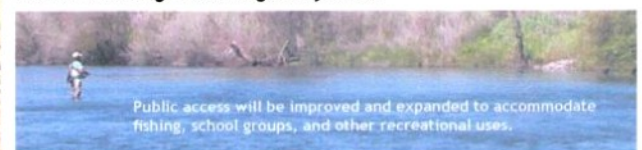
Coarse Sediment Augmentation

The series of upstream dams blocks any supply of gravel to the DTR. The only source, currently, is periodic augmentation by CDFG at select riffles immediately downstream of Crocker-Huffman Dam to benefit spawning salmon. Any transported gravel is trapped by large, deep pools (resulting from gold dredging and subsequent changes to the river) reducing the amount of suitable fish habitat downstream.

When the channel is restored, these large holes will be filled with gravel suitable for salmon spawning. In addition, gravel will be added periodically from upstream so that, over time, gravel transport continuity is re-established. This will provide the river with material to function in ways similar to that of an unimpacted, naturally dynamic river capable of developing and supporting habitats preferred by native aquatic and terrestrial species.

Public Access

This project will capitalize on existing public access on the north side of the property (Cuneo Fishing Access), and provide improvements to existing parking and restroom facilities and the addition of picnic areas and walking trails. Interpretive signs will be added along the trails to promote public awareness of site history, the restoration process, and local plants and animals, including information on salmon life stages and migratory birds.

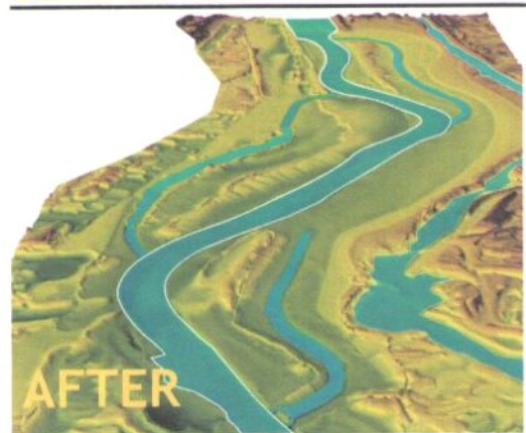


Public access will be improved and expanded to accommodate fishing, school groups, and other recreational uses.

Summarizing the changes



- Channel too wide for current flows on the Merced River
- River unable to overtop its banks and inundate the floodplain
- Limited quantity and quality of spawning and rearing habitat for native salmon and trout
- Large "holes" trap gravel and disrupt sediment transport and rejuvenation of downstream habitat
- Sparse vegetation
- Limited areas of quality habitat for wildlife



- Channel rescaled to match current flows on the Merced River
- Periodic overtopping of banks and inundation of adjacent floodplain
- Increased quantity and quality spawning and rearing habitat for native salmon and trout
- Long-term plan in place to ensure periodic replenishment of gravels
- Large scale replanting of native grasses, shrubs and trees
- Increased quality areas of habitat for wildlife
- Existing public access improved and expanded

Monitoring and Evaluation

A rigorous monitoring plan has been devised to evaluate the performance of restoration actions, provide information useful to the future management of the site, and maximize the generation of data useful to future restoration projects in the region.

What next?

The future of restoration at the MRR is contingent upon completing and obtaining all required environmental compliance documents and permits and securing adequate funding for the phased implementation of the project.

Implementing this project will not only yield significant ecosystem benefits but, through monitoring and evaluation, will provide restoration practitioners with valuable lessons and experiences to apply to restoration projects elsewhere on the Merced River and in the Central Valley.

*There's still a lot left to do!
To find out how you can
get involved, contact:*

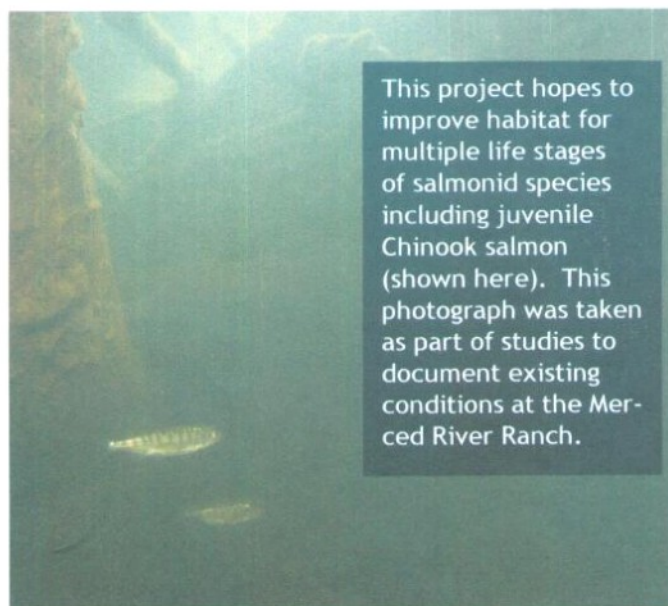
Tim Heyne (CDFG)
(209) 853-2535

Merced
River
Ranch

500 0 500 1,000
Meters

Direction of Flow

With an estimated 4,800 acres of floodplain impacted by dredger tailings in the DTR, the outcomes of the MRR restoration project can provide significant guidance to future restoration and tailing-removal efforts in the reach.



This project hopes to improve habitat for multiple life stages of salmonid species including juvenile Chinook salmon (shown here). This photograph was taken as part of studies to document existing conditions at the Merced River Ranch.

The Foundation

The following technical reports and construction schematics have

resulted from the studies and modeling conducted at the MRR and throughout the DTR, and provide the foundation for the science-based restoration design presented in this summary report:

- 2004. Channel and floodplain surveys of the Merced River Dredger Tailings Reach.
- 2004. Sediment transport model of the Merced River Dredger Tailings Reach.
- 2004. Hydraulic model of the Merced River Dredger Tailings Reach.
- 2004. Volume and texture analysis of the of the Merced River Dredger Tailings.
- 2004. Mercury assessment of the Merced River Ranch.
- 2005. Conceptual restoration design for the Merced River Ranch.
- 2006. Baseline monitoring of the Merced River Dredger Tailings Reach.
- 2006. Merced River Ranch Channel-floodplain Restoration: Design Rationale
- 2006. Merced River Ranch Channel-floodplain Restoration: 75% design drawings and specifications.
- 2006. Merced River Ranch Channel-floodplain Restoration: Post-implementation monitoring plan.
- 2006. Merced River Ranch Channel-floodplain Restoration: Implementation plan and researched cost estimate.
- 2006. Suite of environmental documentation: Wetlands delineation, cultural resources survey, and valley elderberry longhorn beetle survey.
- 2006. Merced River Ranch revegetation experiment.
- 2006. Groundwater monitoring and evaluation of the Merced River Ranch.

For more information and full report text, go to merced.stillwatersci.com.

This research was funded by a CALFED Ecosystem Restoration Program grant to Stillwater Sciences in collaboration with the California Department of Fish and Game.

To get involved, or for other inquiries, contact:
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Prepared by



Stillwater Sciences

November 2006

Additional information on this project is available for download at:

merced.stillwatersci.com