

APPENDIX Q

Measure Screening

APPENDIX Q MEASURE SCREENING

Six non-structural and fourteen structural measures were evaluated and screened based on the Corps screening criteria of effectiveness, efficiency and acceptability. The criteria for each measure was rated using a high/medium/low metric (described below for each criteria). The expertise of the PDT members was used to determine the screening ratings.

Effectiveness. Effectiveness is the extent to which a measure achieves the planning objectives. Measures that clearly make little or no contribution to the planning objectives should be dropped from consideration.

- Metric 1: Flood damage reduction – whether an alternative reduces flood damages in the project area from overbank flows from Corte Madera Creek.
- Metric 2: Human life and safety – whether an alternative reduces the risk of fluvial flooding on human life and safety in the cities of Kentfield and the Town of Ross.

Efficiency. Efficiency of a measure is the cost effectiveness and economic optimization of the measure expressed in net benefits. Benefits can be both monetary and non-monetary. Measures that provided little benefit relative to cost should be dropped from consideration.

- Metric 1: Qualitative assessment of potential for net benefits (no actual costs were estimated, only scale of expense)
- Metric 2: Qualitative assessment of incremental cost and constructability (i.e., whether the project features are potentially economically justified by each unit)

Acceptability. Acceptability is a measure of the ability to implement a measure. In other words, acceptability means a measure is technically, environmentally, economically, and socially feasible. The measures developed for all of the alternative plans are generally considered satisfactory methods of addressing flooding problems. While some measures are more preferable than others to the public, all should be acceptable. Measures that are clearly not feasible should be dropped from consideration.

Non-Structural Measures

Real Estate Acquisition and Relocation (Retained)

Acquiring flowage easements or purchasing lands in fee title to allow flooding and limit future development can reduce flood damages and provide opportunities for improved environmental quality. The measure may have low effectiveness because roadways would still be flooded. This measure may also have low efficiency due to the high cost of real estate in the study area.

Flood Proof Structures – Raising, Ring Levees, Floodwalls, and Sealants (Retained)

Dry flood proofing involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials, and using shields for covering and protecting openings from floodwaters. In areas of shallow, low-velocity flooding, shields can be used on doors, windows, vents, and other building openings. Dry flood proofing should be employed on buildings constructed of concrete block or brick veneer on a wood frame. Weaker construction materials, such as a wood frame, will fail at much lower water depths from hydrostatic pressure. This measure would also involve the raising of individual structures above the level of floodwater reached during a flood. Each structure would be elevated sufficiently to prevent floodwater

intrusion into the structure. Commonly, the structure would be raised and a new foundation constructed beneath it at a higher elevation. This measure would not appreciably reduce flood risk because these individual structures would be isolated during high water and movement and transportation to and from the structure could be dangerous. This measure is best employed by individual property owners to reduce flood damages and will be recommended for all alternatives in which there are areas that will experience infrequent flooding. The measure may have low effectiveness because roadways would still be flooded.

Emergency Warning System and Emergency Preparedness Plan (Retained)

This measure would involve the development of an emergency response plan for the watershed. An emergency plan would contain instructions as to where and when residents should be informed of potentially-dangerous situations, how public agencies should respond to a potential flood emergency, what roads might be blocked off to prevent residents from driving into dangerous water crossings, and other information that would assist in an orderly, coordinated response to the problem. Installation of stream gauges and rain gauges connected to an electronic system could also help to warn residents of the floodplain as to an impending flood. This would allow residents some time to remove limited household property to a safer location prior to a flood event. Flood warning systems can be integrated into a larger flood response plan, potentially in conjunction with evacuation plans. The effectiveness of this measure is limited because the plan does not reduce damage and there is a short lead time for evacuation. There is a system in place which could potentially be modified or improved.

Floodplain Management (Evacuation, Education, Emergency Action Plan, etc.) (Retained)

This is already occurring in the project area and will continue to occur.

Flood Insurance (Retained)

Residents that live within the 1 percent (100-year) ACE flood event floodplain and have federally-backed mortgages are required to pay for FEMA flood insurance. This measure will be retained for those portions of the floodplain that remain in the designated FEMA floodplain after the implementation of the project. Federally subsidized flood insurance is provided through the National Flood Insurance Program (NFIP), and is administered by FEMA. If the resulting recommended plan does not provide a FEMA certifiable 100-year level of protection the NFIP will continue to be implemented.

Reduce Authorized Capacity (Retained)

Currently Units 1, 2, and 3 have an authorized project performance based on the SPF of approximately a 250-year flood event, but the actual project performance for all Units is much less. Unit 1 currently has capacity of approximately a 100-year flood event or greater, but less than the SPF. Therefore Unit 1 can be re-authorized to match the project performance selected for Units 2, 3, and 4 at the completion of the study (since the expected project performance is expected to be less than 100-year).

Structural Measures

Bypass Culverts (Retained)

This measure was originally screened out because it was thought it was not cost effective and same level of effectiveness is likely achievable with less expensive measures. However, through additional

formulation, a cost efficient and effective design, in Unit 4 along Sir Francis Drake Blvd., was identified and thus retained.

Raise Bridges (Retained {Units 2 & 3 only})

This measure would involve raising bridges to supply additional capacity in the channel. The bridge raise could use wing walls, or not, to help guide the flow and increase capacity further. The project may also possibly need culverts in some bridge abutments to increase flow capacity near bridge constrictions. This measure is much more expensive to implement than other measures for the potential range of project performance being considered for this project and will be dropped from general consideration, but may be needed for existing pedestrian and other bridges in Units 2 and 3 to develop an implementable project.

Dams: New or Increase the Storage Capacity of Existing Dams Upstream (Dropped)

This measure would involve increasing the storage capacity of existing dams or identifying new locations suitable for siting a new dam upstream and outside of the project area in order to attenuate flood flows downstream. No sites for a new dam were identified and increasing the capacity of existing dams would be economically infeasible and would face incredible institutional barriers as there would be extreme social and environmental impacts.

Off-Stream Detention Basin (Dropped)

Upstream detention basins are being developed by the sponsor and are already considered as part of the base future without project conditions.

Modification of the Discharge Pipe at Phoenix Lake (Dropped)

This measure would change the operations of the existing Phoenix Lake detention basin to reduce peak flows into Unit 4. However, the pipe is already being developed by the sponsor and are already considered as part of the base future without project conditions.

Remove Concrete and Widen the Channel (Dropped)

This would require doubling the width of the channel in Units 2 and 3 and in some areas of Unit 4. The real estate acquisition required would result in excessive costs and implementability concerns.

Widening Channels in Select Areas Where Constriction Exists (Retained)

There are many areas where there is room to widen the channel. The channel widening at the channel's banks can consist of sloped banks, natural sloped banks, or terraced banks.

Deepen Channel (Retained)

Although in some cases expensive and may result in increased maintenance costs, channel deepening would provide flood risk management benefits.

Channel Deepening in Select Areas for the Purpose of Creating Sediment Traps (Dropped)

The measure is not efficient as it would result in high mitigation and O&M costs. There is a risk that ESA compliance could not be achieved.

Removal of Concrete Channel and Changing Channel to Natural Grade (Retained)

Adjusting the channel to a more natural grade has the potential to reduce O&M due to sediment deposition and therefore improve long term flood risk management.

Setback Levees (Retained in Units 2 and 3)

In Unit 4, real estate footprints and costs would result in excessive costs and implementability concerns.

Floodwalls on Along the Channel Banks (Retained)

For the most highly constrained urban project areas, floodwalls may be the most cost effective measure to address project objectives. However, this measure has negative tradeoffs. Floodwalls are expected to result in significant environmental impacts caused by the increase in flow velocities during medium to high flows. High velocities create migration barriers for ESA listed species and are not acceptable by project resource agency partners for large lengths of the project area. In addition, there is public concern that floodwalls reduce the aesthetic value of the river and creeks by eliminating the public's view and limiting access to the river

Setback Floodwalls (Retained)

This measure would involve the construction of new floodwalls offset from the channel. Additional rights-of-way would need to be acquired by purchase of property from existing landowners. Offset floodwalls would create additional discharge capacity without increasing the height required for traditional floodwalls. Offset floodwalls could reduce operations and maintenance costs if the surface water elevation and associated erosion is reduced. Incidental benefits include habitat and water quality improvements associated with a functioning riparian and floodplain corridor.

Raising Channel Retaining Walls in Units 2 and 3 (Retained)

This measure would raise existing retaining walls in Units 2 and 3 to effectively turn them into floodwalls.

Bench Excavation and Retaining Wall Setback (Leave Concrete) (Retained)

This measure would involve the excavation of the floodplain bench material to create a response system for low flow events other than storm events.

Stem Wall to Restore Super Critical Flow to Address Fish Passage (Dropped)

The measure was screened out because it does not address the flood risk objective.

Supplemental Subsurface Culvert (Dropped)

The PDT determined that there would be excessive cost, construction needs, environmental concerns, and operational concerns associated with this measure.

Change Alignment of Channel (Dropped)

Changing the channel alignment is not feasible due to the high concentration of public and private infrastructure in the project area.

Modify and Armor Channel banks in select areas (Retained)

This measure may be appropriate for some portions of the channel to increase discharge capacity.

Obstruction Removal – Trees, Boulders, Fish Ladder (Retained)

This measure focuses on increasing channel capacity through clearance of impediments to flow.

Replace Fish Ladder (Dropped)

The fish ladder results in debris hazard, pinch point and does not properly function. Will be replaced with more functional options.

Remove Fish Ladder, Headwall Abrupt Transition (Dropped)

A headwall will result in hydraulic jump and unacceptable fish passage.

Remove Fish Ladder, Replace with Smooth Transition (Retained)

This measure may include fish resting pools, channel bed stabilization, etc.

Interior Drainage (Dropped)

All FRM projects have residual risk associated with them. Modification of the interior drainage system is one way to plan for and reduce residual risk. The PDT has determined that this measure will not effectively meet the project objectives at this project site.

Sediment Removal (Retained)

Currently, the project's OMRR&R manual requires sediment removal, however, based on new data the sediment removal required by the current OMRR&R manual has been deemed unrealistic. Therefore, an adjustment to the current required regular sediment removal considered a future without project condition will be adjusted based on available data and the OMRR&R manual will be updated to reflect this.

Summary of Measures

Table F-1 summarizes the screening criterion and outcomes of the measures for the Project.

TABLE F-1 MEASURE SCREENING SUMMARY					
Measure	Effective	Efficiency	Acceptable	Carry Forward	Notes
Unit 4					
Widening throughout study area	High	Medium	Low	No	Cost prohibitive, no available real estate to widen along entire stretch
Bridge raises and wing walls	High	Low	Low	No	Too expensive ; other measures can achieve similar performance at less cost
Dams	High	Low	Low	No	Lack of opportunities for new dams; cost prohibitive.
Widening at select areas where constriction exists	High	High	High	Yes	
Change bank slope, increase steepness and armor in selected areas	High	High	Medium	Yes	Bridges and individual sheet pile retaining walls exist in the channel. The Royston Plan includes a new park north of the post office.
Deepening	Medium	Low	Medium	Yes	Although expensive, the risk profile is lowered

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TABLE F-1 MEASURE SCREENING SUMMARY					
Measure	Effective	Efficiency	Acceptable	Carry Forward	Notes
Deepening in select areas, sediment traps	Low	Low	Low	No	Environmental acceptability is low, effectiveness & efficiency is low due to large O&M costs and environmental restrictions,
Change grade of channel to natural grade	Low	Medium	Medium	Yes	
Levees	High	Low	Medium	No	Real estate footprints and costs would result in excessive costs and implement-ability concerns
Levees in certain areas where feasible	High	Medium	Medium	No	Real estate footprints and costs would result in excessive costs and implement-ability concerns specific to Unit 4.
Floodwall on river bank along entire reach	High	Medium	Low	Yes	Note this is not expected to be an acceptable plan to public
Floodwalls on river bank in certain areas, where constriction exists	High	Medium	Medium	Yes	
Setback floodwalls along entire reach	High	Low	Low	No	Real estate footprints and costs would result in excessive costs and implement-ability concerns
Setback floodwalls in certain areas where breakout is present	Medium	Medium	Low	Yes	
Bypass Channel	High	High	High	Yes	
Supplemental subsurface culvert	Medium	Low	Medium	No	Excessive cost, environmental concerns, operational concerns, excessive construction needs
Upstream detention basins	High	Low	Low	No	These in-kind measures may be carried out independently by the NFS.
Modification of the discharge pipe at Phoenix Lake	Medium	Low	Medium	No	Outside of study Area
Obstruction removal from channel	Medium	High	Low	Yes	Site prep work needed to ensure desired channel capacity
Change alignment of channel	Low	Low	High	No	Not effective, channel already straight

TABLE F-1 MEASURE SCREENING SUMMARY					
Measure	Effective	Efficiency	Acceptable	Carry Forward	Notes
Flood proofing of individual properties (raising)	Medium	Medium	Medium	Yes	
Flood proofing of houses within setback floodwalls	Medium	High	Medium	Yes	
Property acquisition	High	Low	Low	No	Cost prohibitive.
Property acquisition within setback floodwalls	High	Medium	Low	No	Cost prohibitive.
Ring levee	Low	Low	Low	No	Results in risk to residences within ring levee and does not meet objectives.
Flood Warning System	Low	High	High	Yes	Current existing condition.
Flood Plain Management (evacuation, education, emergency action plan, etc.)	Low	High	High	Yes	Current existing condition.
Interior drainage/runoff	Low	Low	High	No	Does not address objectives.
Interior drainage/runoff in combination with levees and floodwalls	Low	Low	High	No	Does not address objectives.
Unit 3/4 Transition					
Replace fish ladder in kind	Low	Low	Low	Yes	The fish ladder results in debris hazard, pinch point and does not properly function. Will be replaced with more functional options.
Remove fish ladder, replace with smooth transition	High	High	High	Yes	Measure may include fish resting pools, channel bed stabilization, etc.
Remove fish ladder, headwall abrupt transition	No	Medium	Low	No	Will result in hydraulic jump and unacceptable fish passage for ESA listed Steelhead.
Units 2 & 3					
Remove the concrete, widen, and reset slopes	Medium	Low	Low	No	Cost prohibitive as you would need double the width to carry the capacity.
Bridge raises and wing walls	High	Low	Medium	Yes	Expensive, but may be necessary to replace existing pedestrian and medical bridge as a project cost.
Widening	High	High	High	Yes	Amount of widening will be limited by the amount of real estate available.

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TABLE F-1 MEASURE SCREENING SUMMARY					
Measure	Effective	Efficiency	Acceptable	Carry Forward	Notes
Remove concrete and widen	Medium	Low	Low	No	Cost prohibitive due to public and private infrastructure.
Bench excavation and retaining wall setback (leave concrete) to create a response system for low flow events other than storm events	High	Medium	Medium	Yes	
Change alignment of channel	Medium	Low	Low	No	Cost prohibitive due to public and private infrastructure.
Deepening	High	Low	Low	No	Not feasible from a hydraulic perspective.
Raising channel retaining walls (turning into floodwalls) limit 2 feet	High	Medium	Medium	Yes	
Levees on river bank	High	Medium	Medium	Yes	Where land is available levees are typically less expensive than floodwalls.
Floodwalls on river bank	High	Medium	Medium	Yes	Where land is limited, floodwalls may be the only practical solution.
Setback levee	High	Medium	Medium	Yes	See notes above.
Setback floodwalls	High	Medium	Medium	Yes	See notes above.
Bypass channels	Low	Low	Low	No	Cost prohibitive due to public and private infrastructure.
Upstream detention basins	High	Low	Low	No	These kind measures may be carried out independently by the NFS.
Tree/obstruction removal	Low	Low	Low	No	Channel is concrete, therefore not applicable.
Flood proofing below designed flood event (1st floor elevation)	Medium	High	Medium	Yes	
Property acquisition	High	Low	Low	No	Cost prohibitive to acquire the entire footprint of floodplain.
Ring levee	Low	Low	Low	No	Results in risk to residences within ring levee and does not meet objectives.
Flood warning system	Low	High	High	Yes	Current existing condition.
Flood Plain Management (evacuation, education, emergency action plan, etc.)	Low	High	High	Yes	Current existing condition.
Interior drainage	Low	Low	High	No	Does not address objectives.

TABLE F-1 MEASURE SCREENING SUMMARY					
Measure	Effective	Efficiency	Acceptable	Carry Forward	Notes
Sediment removal	Medium	High	high	Yes	New baseline will be included by as part of the routine O&M.
Unit 1					
Reduce authorized capacity	High	High	High	Yes	Selected plan should have the same project performance for Units 1, 2, 3, & 4.