Evaluation of Portfolio Performance and Trade-offs in Management of Future Central Valley System Risks

Michael Tansey - Reclamation

RECLAMATION

Basin Study Resource Categories

Selected Performance Metrics

1. Water Delivery

Total Unmet Demands, End-of September Sacramento Valley Storage, CVP/SWP Delta Exports

2. Water Quality

Delta salinity, End-of-May Shasta Storage

3. Hydropower

CVP Net Hydropower Generation

4. Flood Control

Folsom Reservoir flood control pool

5. Recreation

- Lake Oroville surface area
- 6. Fish and Wildlife Habitats
 - Peleagic Species Delta habitat
- 7. ESA Species
 - Adult salmon migration in Delta
- 8. Flow dependent eco-resiliency
 - Sacramento River floodplain flow processes

RECLAMATION

Water Delivery – Total Unmet Demands

Resource Category	Performance Metric	Performance Indicator	Indicator Change
Water Delivery	Total Unmet demands	Unmet demands are differences between total water needs and available supply from all sources.	Decreases in the unmet demand indicator imply that water delivery reliability is increasing.

Portfolio Comparisons by Scenario

Water Management	Least	Regional	Healthy	Delta	Expanded	Flexible	Water
Action	Cost	Self- Reliance	Headwaters &	Conveyance and	Water Storage	System Operations	Action Plan
		Reliance	∝ Tributaries	Restoration	Storage	operations	Fian
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
Enhance Groundwater Recharge		Operations			Operations	Operations	Operation
Improve Tributary Environmental Flows			Operations				Operation
Improve System Conveyance	Operations			Operations	Operations		Operation
Increase Sac Valley Surface Storage	Operations				Operations		Operation
Increase SJ Valley Surface Storage					Operations		Operation
Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

No Action vs RF_CT

No Action

Improved performance (green bar) Decreased performance (red bar) Performance Change < + or – 10% Right side (improved) Left side (decreased)

Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded Water	
Storage & GW	
Flexible System	
Operations	
Water Action	
Plan	

Water Delivery – End-of-Sept Storage

Resource Category	Performance Metric	Performance Indicator	Indicator Change
Water Delivery	End-of- September reservoir storage	Sacramento Valley storage is less than 10% of historical end-of- September storage as represented by the Historic Reference scenario	Decreases in this end-of- September storage indicator imply that water delivery reliability is increasing.

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Reliance	&	Delta Conveyance and Restoration	Expanded Water Storage	Flexible System Operations	Water Action Plan
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
Enhance Groundwater Recharge		Operations			Operations	Operations	Operation
Improve Tributary Environmental Flows			Operations				Operation
Improve System Conveyance	Operations			Operations	Operations		Operation
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Increase SJ Valley Surface Storage					Operations		Operation
Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

No Action vs RF_CT



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Least	
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Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded	
Water Storage	
& GW	
Flexible System	
Operations	
Water Action	
Plan	

Water Delivery – CVP/SWP Delta Exports

Resource Category		rmance etric	Perfo	ormance Indi	cator	Indi	cator Chang	le	No Action	/s RF_CT
Water Delivery	DeliveryDelta exportsFederally mandated Delta wa quality and flow standards ar		e and lta water	Increases in Delta exports imply that water delivery reliability is increasing.			No Action			
			exceeded.	mpariso	ons by S	cenario)		Improved performance	e (green bar)
Water Manage Action	Water Management ActionLeast CostRegional Self- RelianceHealthy HeadwatersDelta Conveyance and Tributaries			Flexible System Operations	Water Action Plan Reduce	Decreased performan Performance Change	ice (red bar) < + or – 10%			
Water Use Effic Increase Urban Water Use Effic	ciency I	Reduce Demand Reduce Demand	Reduce Demand Reduce Demand					Demand Reduce Demand	Right side (improved)	Left side (decreased)
Increase Regio Reuse	nal	Demand	Increase Supply					Increase Supply	Portfolio vs No Action (Cen_CT)	
Increase Ocear Desalination Precipitation Enhancement	ר ר	Increase Supply	Increase Supply Increase Supply					Increase Supply Increase Supply	Least	
Rainwater Harv Conjunctive	vesting		Increase Supply Operations			Operations	Operations	Increase Supply	Cost Regional Self	
Groundwater Management									Reliance	
Enhance Groundwater Recharge			Operations			Operations	Operations		Healthy Headwaters	
Improve Tributa Environmental Improve System	Flows	Operations	5	Operations	Operations	Operations		Operation Operation	Delta Convey &	
Conveyance Increase Sac V Surface Storage	e	Operations	8			Operations		Operation	Restoration	
Increase SJ Va Surface Storage Increase Expor	é	Operations				Operations Operations		Operation Operation	Expanded Water Storage & GW	
Surface Storage Increase Upper Watershed Surf Storage	e					Operations		Operation	Flexible System	
Improve Forest Health		Resource		Resource				Resource	Operations	
Improve Regula Flexibility/Adap		nstitutions	\$				Institutions	Institution	Water Action Plan	

Water Quality – Delta Salinity

Resource Category	Performance Metric	Performance Indicator	Indicator Change
Water Quality	Delta salinity at Jersey Point	Salinity at Jersey Point in the western Delta expressed as electrical conductivity (EC).	Decreases in Delta salinity imply that water quality is improving.

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self-	Healthy Headwaters	Delta Conveyance	Expanded Water	Flexible System	Water Action
Action	0031	Reliance	&	and	Storage	Operations	Plan
			Tributaries	Restoration	J		
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
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Improve System Conveyance	Operations			Operations	Operations		Operation
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Increase SJ Valley Surface Storage					Operations		Operation
Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

No Action vs RF_CT



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Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded	
Water Storage	
& GW	
Flexible System	
Operations	
Water Action	
Plan	

Water Quality – End-of-May Storage

Resource Category	Performance Metric	Performance Indicator	Indicator Change	No Action v	s RF_CT
Water Quality	End-of-May storage at Shasta Lake	The end-of-May storage at Shasta Reservoir is less than the 10 th percentile in the Historic Reference scenario.	Decreases in this indicator imply that water quality is improving.	No Action	

Portfolio Comparisons by Scenario

Water Management	Least	Regional	Healthy	Delta	Expanded	Flexible	Water
Action	Cost	Self-	Headwaters	Conveyance	Water	System	Action
		Reliance	& Taile utonico	and	Storage	Operations	Plan
			Tributaries	Restoration			
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
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Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution



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Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded	
Water Storage	
& GW	
Flexible System	
Operations	
Water Action	
Plan	

Hydropower – Net Generation

Resource Category	Performance Metric	Performance Indicator	Indicator Change	No Action
CVP Net		CVP Net hydropower generation measured in gigawatt hours per	Increases in net generation	No
Hydropower power generation	• • •	imply that hydropower	Action	
	generation	and project use.	benefits are increasing.	

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self-	Healthy	Delta Conveyance	Expanded Water	Flexible System	Water Action
Action	COSI	Reliance	Reauwaters	and	Storage	Operations	Plan
		Renarioe		Restoration	otorage	operatione	. iaii
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
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Increase Sac Valley Surface Storage	Operations				Operations		Operation
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Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

No Action vs RF_CT



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Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded	
Water Storage	
& GW	Į
Flexible System	
Operations	
Water Action	
Plan	

Flood Control – Flood Pool Storage

Resource Category	Performance Metric	Performance Indicator	Indicator Change	No Action vs RF	СТ
Flood Control	Reservoir storage below flood- control pool	The percent of months from October to June when Folsom reservoir storage is within 10 TAF of the flood conservation pool at Folsom Reservoir.	A decrease in this indicator signifies a reduction in flood risk while an increase means less available flood conservation storage and	No Action	
			increased risk.		

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self- Reliance	Healthy Headwaters & Tributaries	Delta Conveyance and Restoration		Flexible System Operations	
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
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Improve System Conveyance	Operations			Operations	Operations		Operation
Increase Sac Valley Surface Storage	Operations				Operations		Operation
Increase SJ Valley Surface Storage					Operations		Operation
Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution



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Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	Į
Expanded Water	
Storage & GW	
Flexible System	
Operations	L .
Water Action	
Plan	

Recreation – Reservoir Surface Area

Resource Category	Performance Metric	Performance Indicator	Indicator Change	No Action vs RF CT	
Recreation	Decervoir	The percent of months from May through September that Lake Oroville surface area is less than the historic period median surface area.	Decreases in this indicator imply that recreational opportunities are improved.	No Action	

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self- Reliance	Healthy Headwaters & Tributaries	Delta Conveyance and Restoration	Expanded Water Storage	Flexible System Operations	Water Action Plan
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
Conjunctive Groundwater Management		Operations			Operations	Operations	Operation
Enhance Groundwater Recharge		Operations			Operations	Operations	Operation
Improve Tributary Environmental Flows			Operations				Operation
Improve System Conveyance	Operations			Operations	Operations		Operation
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Increase SJ Valley Surface Storage					Operations		Operation
Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution



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Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded Water	
Storage & GW	
Flexible System	
Operations	
Water Action	
Plan	

Fish & Wildlife Habitats – Pelagic Species

Resource Category	Performance Metric	Performance Indicator	Indicator Change	
Fish and Wildlife Habitats	Pelagic species' habitats	The percent of months from February to June that 2 ppt salinity (X2) is greater than 74 km east of Golden Gate Bridge.	Decreases in this indicator imply that habitat conditions for Delta smelt are improving.	

No Action vs RF_CT



Improved performance (green bar) Decreased performance (red bar) Performance Change < + or – 10% Right side (improved) Left side (decreased)

Portfolio vs No Action (Cen_CT)

Least	
Cost	
Regional Self	
Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded Water	
Storage & GW	
Flexible System	
Operations	
Water Action	
Plan	

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self- Reliance	&	Delta Conveyance and Restoration	Expanded Water Storage	Flexible System Operations	Water Action Plan
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
Rainwater Harvesting		Increase Supply					Increase Supply
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Improve System Conveyance	Operations			Operations	Operations		Operation
Increase Sac Valley Surface Storage	Operations				Operations		Operation
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Increase Export Area Surface Storage	Operations				Operations		Operation
Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

ESA Species – Adult Salmon

Resource Category	Performance Metric	Performance Indicator	Indicator Change
ESA Species	Adult salmonid migration	The frequency of reverse flows in the OMR channels of the San Joaquin River more negative than -5,000 cfs.	Decreases in the occurrence of reverse OMR flows imply that adult salmon migration conditions are improved.

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self- Reliance	&	Delta Conveyance and Restoration	Expanded Water Storage	Flexible System Operations	
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
Precipitation Enhancement	Increase Supply	Increase Supply					Increase Supply
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Increase Upper Watershed Surface Storage					Operations		Operation
Improve Forest Health	Resource		Resource				Resource
Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

No Action vs RF_CT



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Least Cost	
Regional Self Reliance	
Healthy Headwaters	
Delta Convey & Restoration	
Expanded Water Storage & GW	
Flexible System Operations	
Water Action Plan	

Eco-Flow Resilency – Floodplain Processes

Resource Category	Performance Metric	Performance Indicator	Indicator Change				
Flow- dependent Ecological	Floodplain processes	The percent of months from February through June that flows on the Sacramento River at	Decreases in this indicator would imply that floodplain	No Action	VS RF_CT		
Resiliency	Keswick are less than the 15,000 cfs	processes are improved.	Action	ļ			

Portfolio Comparisons by Scenario

Water Management Action	Least Cost	Regional Self- Reliance	Healthy Headwaters & Tributaries	Delta Conveyance and Restoration	Expanded Water Storage	Flexible System Operations	Water Action Plan
Increase Agricultural Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Urban Water Use Efficiency	Reduce Demand	Reduce Demand					Reduce Demand
Increase Regional Reuse		Increase Supply					Increase Supply
Increase Ocean Desalination		Increase Supply					Increase Supply
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Improve Regulatory Flexibility/Adaptability	Institutions					Institutions	Institution

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Least	
Cost	
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Reliance	
Healthy	
Headwaters	
Delta Convey &	
Restoration	
Expanded Water	
Storage & GW	
Flexible System	
Operations	
Water Action	
Plan	

Decision Support & Tradeoffs

Resource Categories	Performance Metrics	No Action	Least Cost	Regional Self Reliance	Healthy Headwaters	Delta Conveyance & Restoration	Expanded Water Storage & Groundwater	Flexible System Operations	Water Action Plan
	Unmet Demands								
Water	End-of-Sept Storage								
Delivery	CVP/SWP Exports								
Water	Delta Salinity								
Quality	End-of-May storage								
Hydropower	CVP Net Generation								
Flood Control	Reservoir Flood Control								
Recreation	Reservoir Surface Area								
Fish & Wildlife	Pelagic species								
Habitats	Food web productivity								
ESA	Adult Salmon Migration								
Species	Cold-water Pool								
Eco- flow Resilency	Floodplain Processes								

No Action CEN_CT to RF_CT

Portfolio Comparisons to No action CEN_CT only