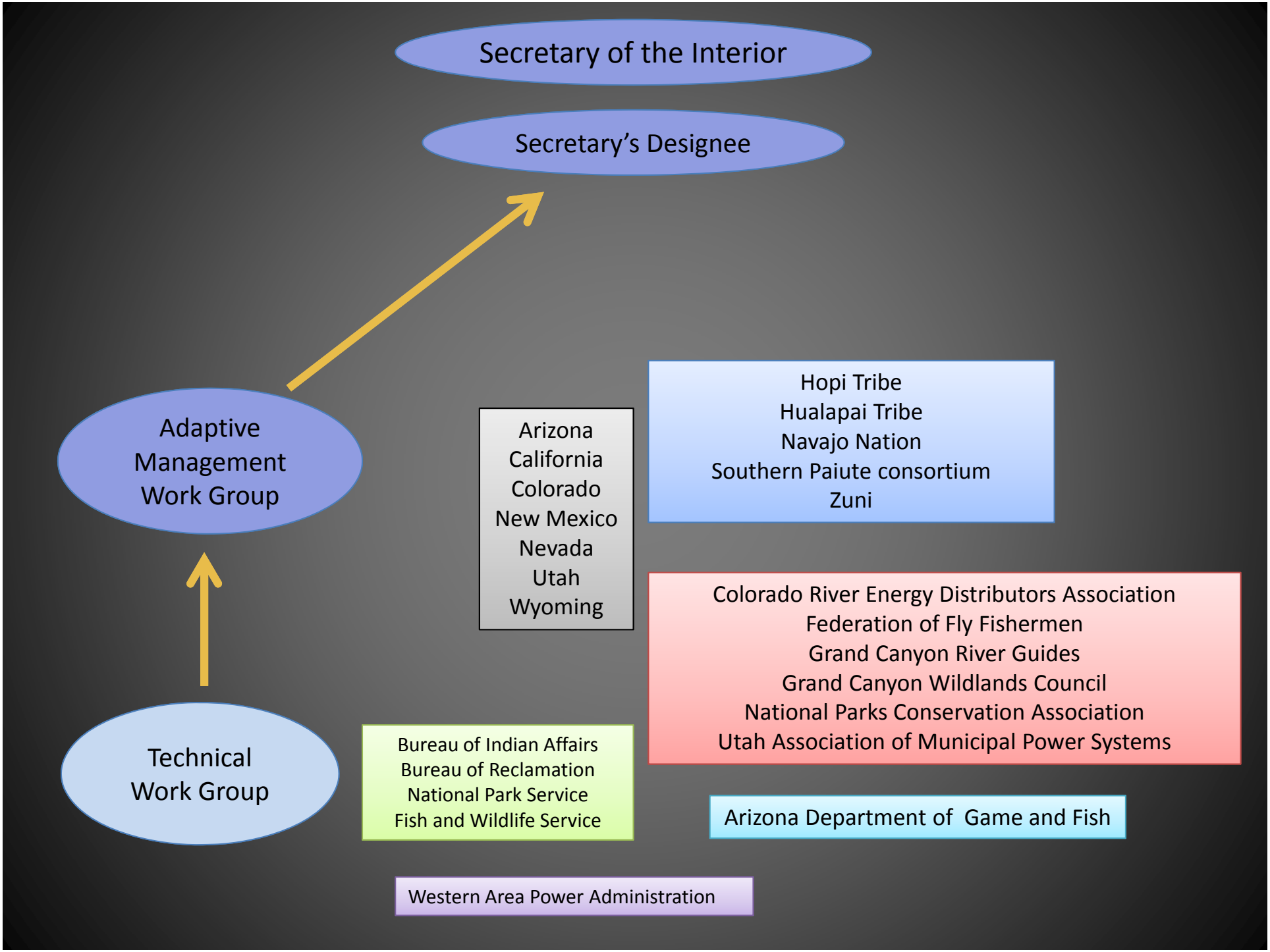
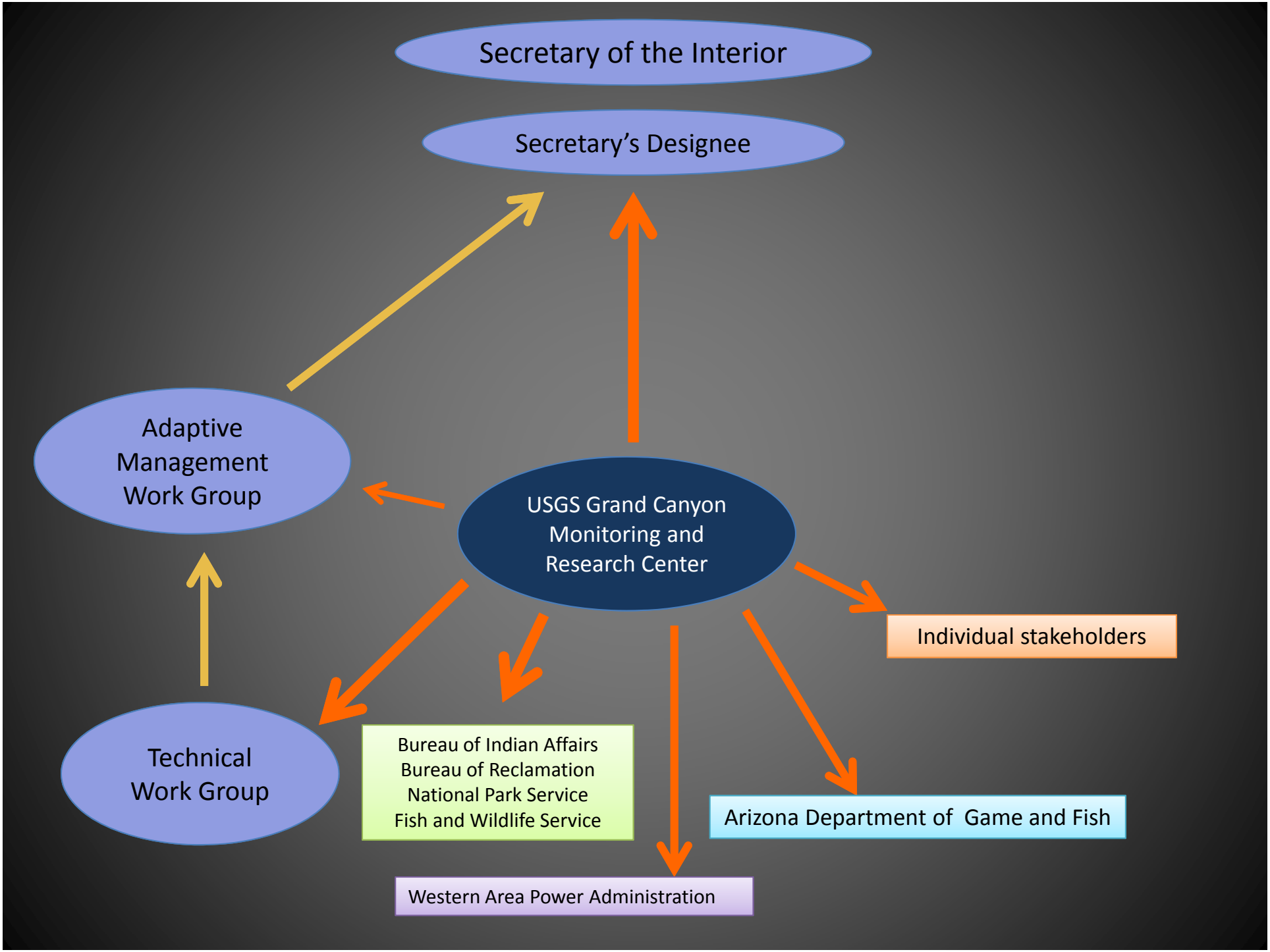
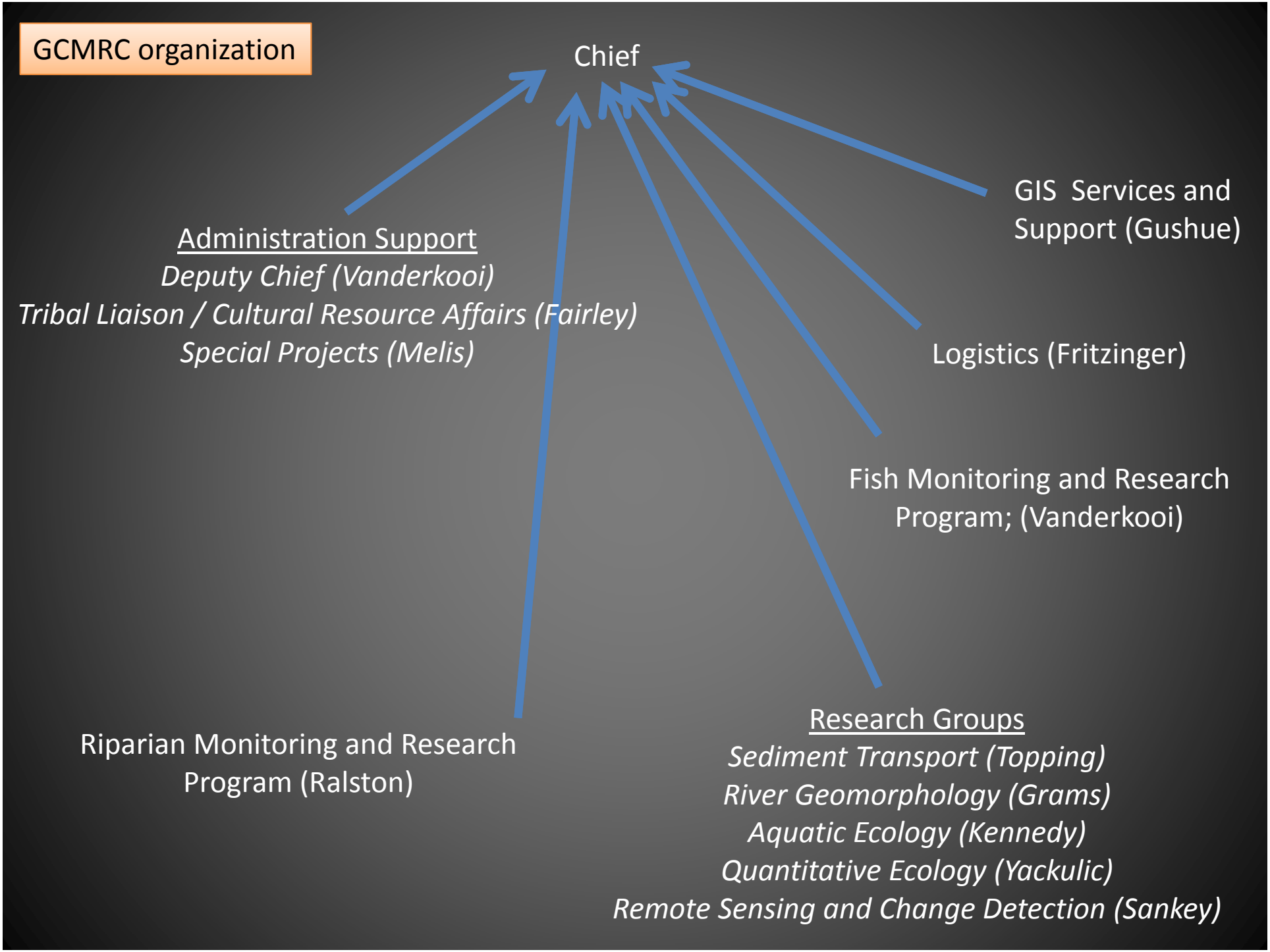
Development of the FY15–17 GCMRC Work Plan and Budget

Jack Schmidt
Grand Canyon Monitoring and Research Center
Southwest Biological Science Center
US Geological Survey
June 2014


Secretary of the Interior
Secretary's Designee
Adaptive Management Work Group
Technical Work Group
Arizona
California
Colorado
New Mexico
Nevada
Utah
Wyoming
Hopi Tribe
Hualapai Tribe
Navajo Nation
Southern Paiute consortium
Zuni
Colorado River Energy Distributors Association
Federation of Fly Fishermen
Grand Canyon River Guides
Grand Canyon Wildlands Council
National Parks Conservation Association
Utah Association of Municipal Power Systems
Bureau of Indian Affairs
Bureau of Reclamation
National Park Service
Fish and Wildlife Service
Arizona Department of Game and Fish
Western Area Power Administration


Secretary of the Interior
Secretary's Designee
Adaptive Management Work Group
USGS Grand Canyon Monitoring and Research Center
Individual stakeholders
Technical Work Group
Bureau of Indian Affairs
Bureau of Reclamation
National Park Service
Fish and Wildlife Service
Arizona Department of Game and Fish
Western Area Power Administration


GCMRC organization
Chief
GIS Services and Support (Gushue)
Administration Support
Deputy Chief (Vanderkooi)
Tribal Liaison / Cultural Resource Affairs (Fairley)
Special Projects (Melis)
Logistics (Fritzinger)
Fish Monitoring and Research Program; (Vanderkooi)
Riparian Monitoring and Research Program (Ralston)
Research Groups
Sediment Transport (Topping)
River Geomorphology (Grams)
Aquatic Ecology (Kennedy)
Quantitative Ecology (Yackulic)
Remote Sensing and Change Detection (Sankey)

Questions, Expectations, Concerns

Assistant Secretary's Guidance concerning research and monitoring priorities in GCMRC science planning (March 2011 and May 2014 memos)

2011 Desired Future Conditions Ad Hoc Group
(April 30, 2012: SoI directed AMWG "to utilize these DFCs to inform and guide the AMWG's future considerations")

Secretarial Directive concerning Environmental Assessments and related Science Plans for (1) High-flow Experimental Releases, and (2) Non-native Fish Control (May 23, 2012: "*I direct … USGS … to undertake coordinated implementation of the actions and commitments described and analyzed in the Environmental Assessments …*")

GCDAMP Documents and Guidance:

Core Monitoring Plan (February 2011, draft)
Strategic Science Plan (April 2009)
Monitoring and Research Plan (April 2009)
Priority Questions (5) and Program Goals (12) (August 2004)

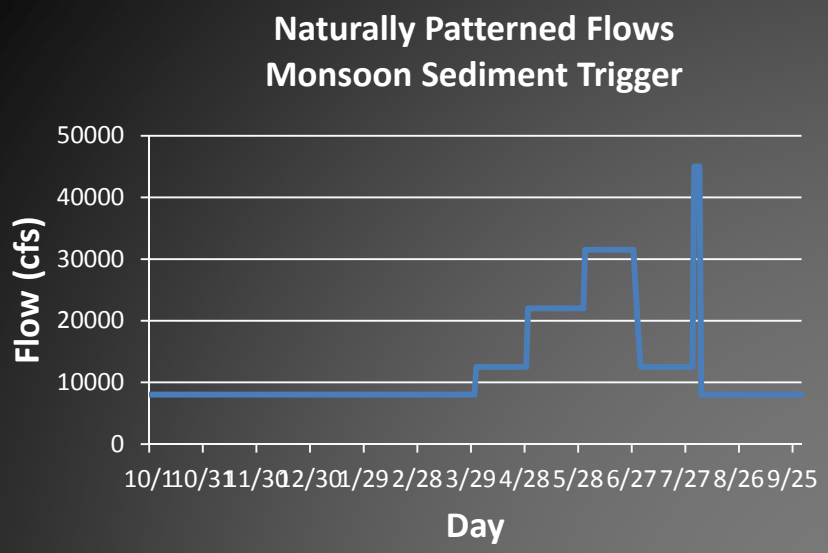
Recent Guidance from Secretary's Designee Regarding Triennial Budget Process and Science Planning Priorities

- "science relevant to compliance with Endangered Species Act, particularly relative to native fish and humpback chub"
- "science informing … compliance with the Grand Canyon Protection Act, especially the sediment resource"
- "science on non-native fish control and the recreational trout fishery"

science priorities originally described in March 2011 for which "the need for this science continues"

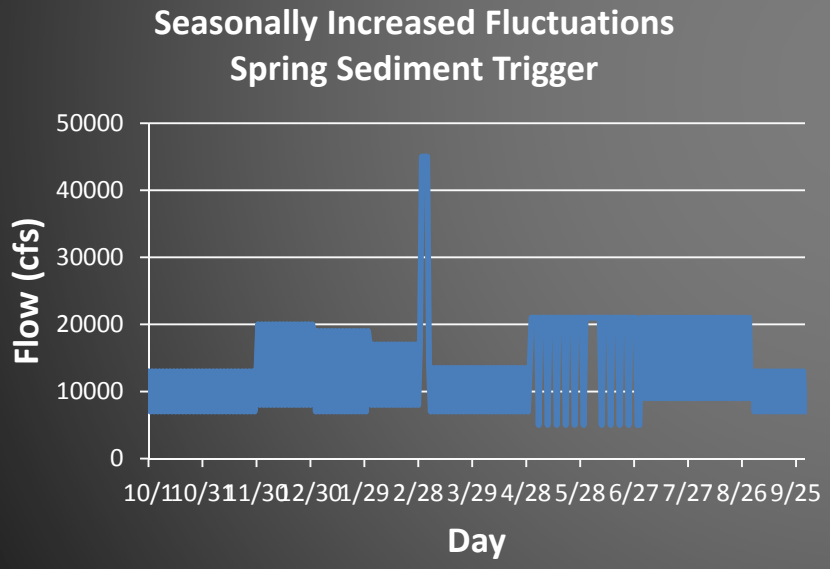
- "the evolving issue related to cultural/archaeological resources as linked to modern river processes"; "understanding … how cultural and archaeological sites are linked to modern river processes"
- "the role of Traditional Ecological Knowledge in contributing to scientific understanding and river operations"
- "other investigations for which there is "widespread support and further the purposes of the Adaptive Management Program"
- "continue … long-term monitoring of core ecosystem components"

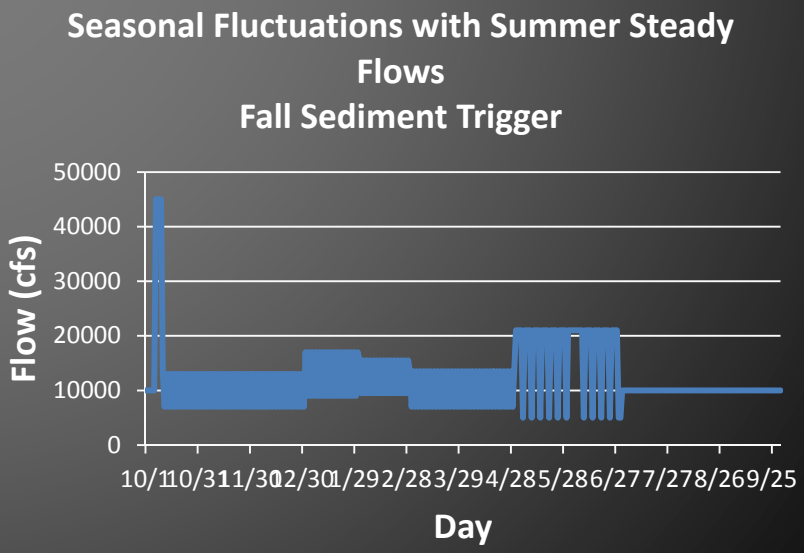
“within the relevant budget constraints”



The Big Unknown …

Long-term Experimental and Management Plan (LTEMP) Environmental Impact Statement, Experiment and Science Plan, and Record of Decision





GCMRC Staff Contributions to LTEMP

Employee	Estimate of hours
L. Bair	100
H. Fairley	80
P. Grams	168
T. Gushue	160
D. Topping	40
S. VanderKooi	80
C. Yackulic	480

The Big Questions in Applied River Science …

What is the largest amount of fine sediment that can occur along the banks of the Colorado River, especially as eddy sandbars?

What flow regime, in relation to the natural supply of fine sediment from tributaries, results in the most widespread distribution of fine sediment along the channel banks and in eddies?

Do larger amounts of fine sediment along the channel banks and in eddies significantly change the amount and distribution of fine sediment that occurs above the active channel and that occurs at or near archaeological sites?

What management strategies should be employed to maintain a high quality rainbow trout fishery in Glen Canyon while protecting, and potentially recovering, the endangered humpback chub fish community in Marble and Grand Canyons?

Guiding Principles in Budget Development

- Each project comprehensively focuses on a particular resource and/or specific questions; each project focuses on key monitoring activities and resolving key management uncertainties.
- To the degree possible, projects should reference each other and be linked with each other.
- Research projects should consider cost effective strategies to resolve knowledge uncertainties. Field-scale experiments should be avoided unless based on previous laboratory experiments, literature reviews, innovative data analysis, and/or comparative studies of other rivers
- Collaborate with land, species, and water management agencies. Pursue cost effective monitoring strategies.
- Report the full cost of each project (i.e., incorporate logistics and remote sensing/GIS costs in the associated science activity)

FY15 Budget Proposal

$8.7 million (GCDAMP funding)

high priority monitoring activities that include required support for HFEP and NNFC EAs, Biological Opinion activities, and other key monitoring activities; includes resolution of some key scientific uncertainties

$0.8 million (supplemental BoR funding)

high priority research activities to resolve some key scientific uncertainties

$0.7 million (unfunded)

recommended additional monitoring and research projects

AMP funds available for GCMRC monitoring and research projects in FY15
~$8.7 million

FY 16 and FY17 Considerations

FY15 -- $8.75 million (GCDAMP funding; $0.80 million BoR supplemental; $0.02 million SBSC) ($8.7 million GCDAMP funds available)

FY16 -- $10.86 million (total GCDAMP request); $9.4 million recommended) ($9.0 million GCDAMP funds available)

FY17 -- $10.71 million (total GCDAMP request) ($9.3 million GCDAMP funds available)

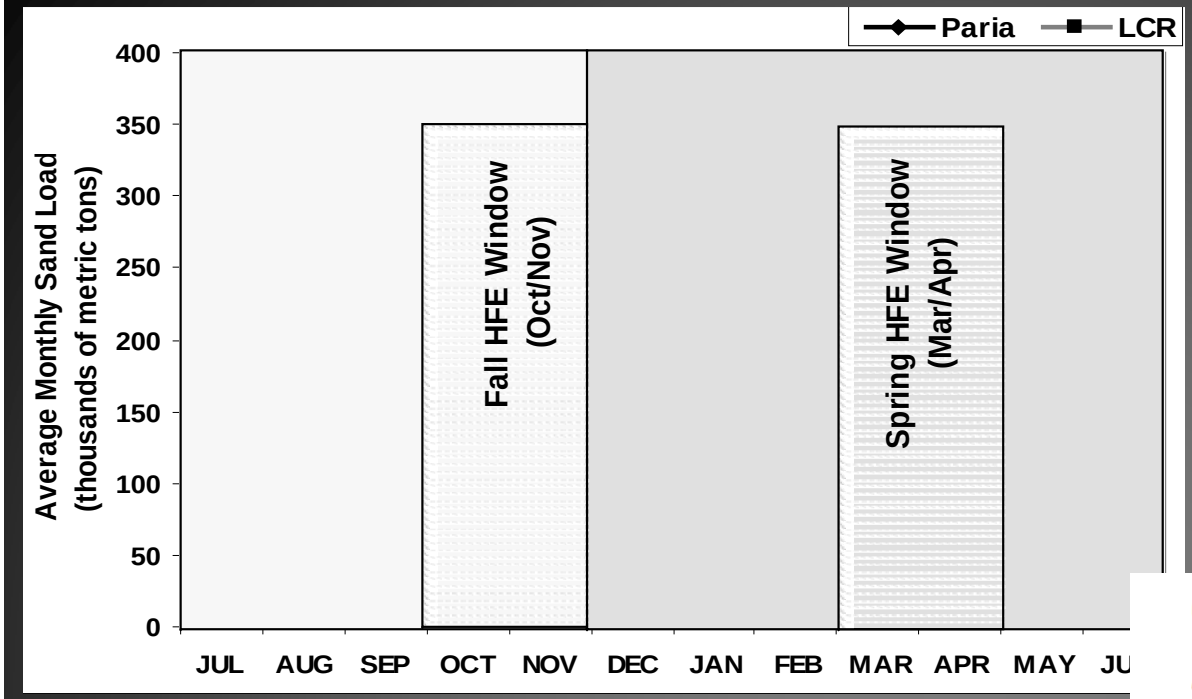
Desired Future Conditions

"high elevation open riparian sediment deposits ... in sufficient volume, area, and distribution ..."

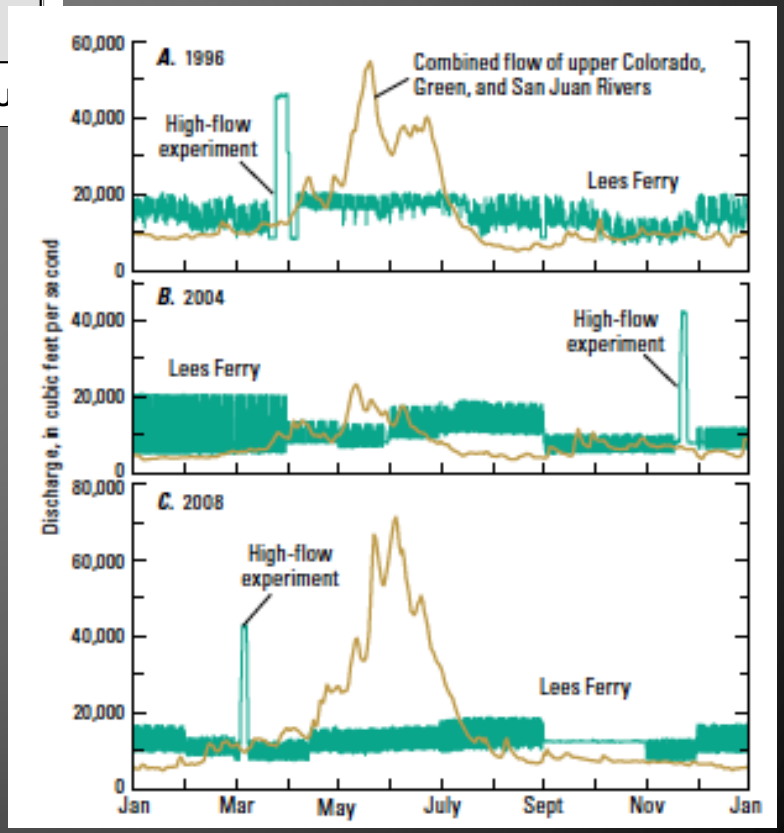
"Physical characteristics, including climate, site-specific geomorphology, dam-related discharge and flow, and tributary flows, generally predominate ..."

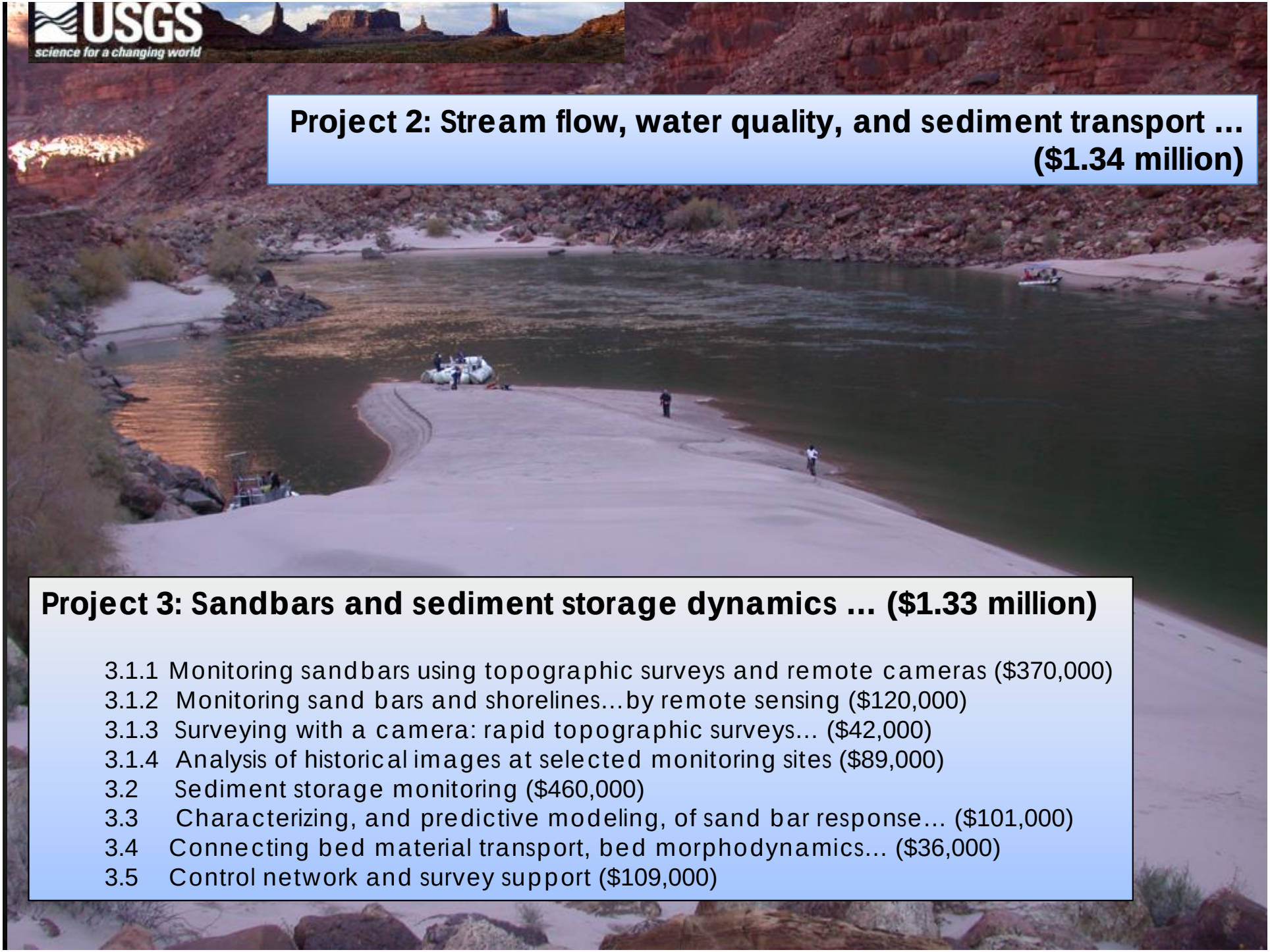
"Water quality with regards to dissolved oxygen, nutrient concentrations and cycling, turbidity, temperature, etc. is sufficient to support natural ecosystem

"... maintain significance and integrity [of] prehistoric archaeological sites and historic sites]"



Decision strategy High Flow Experimental Protocol

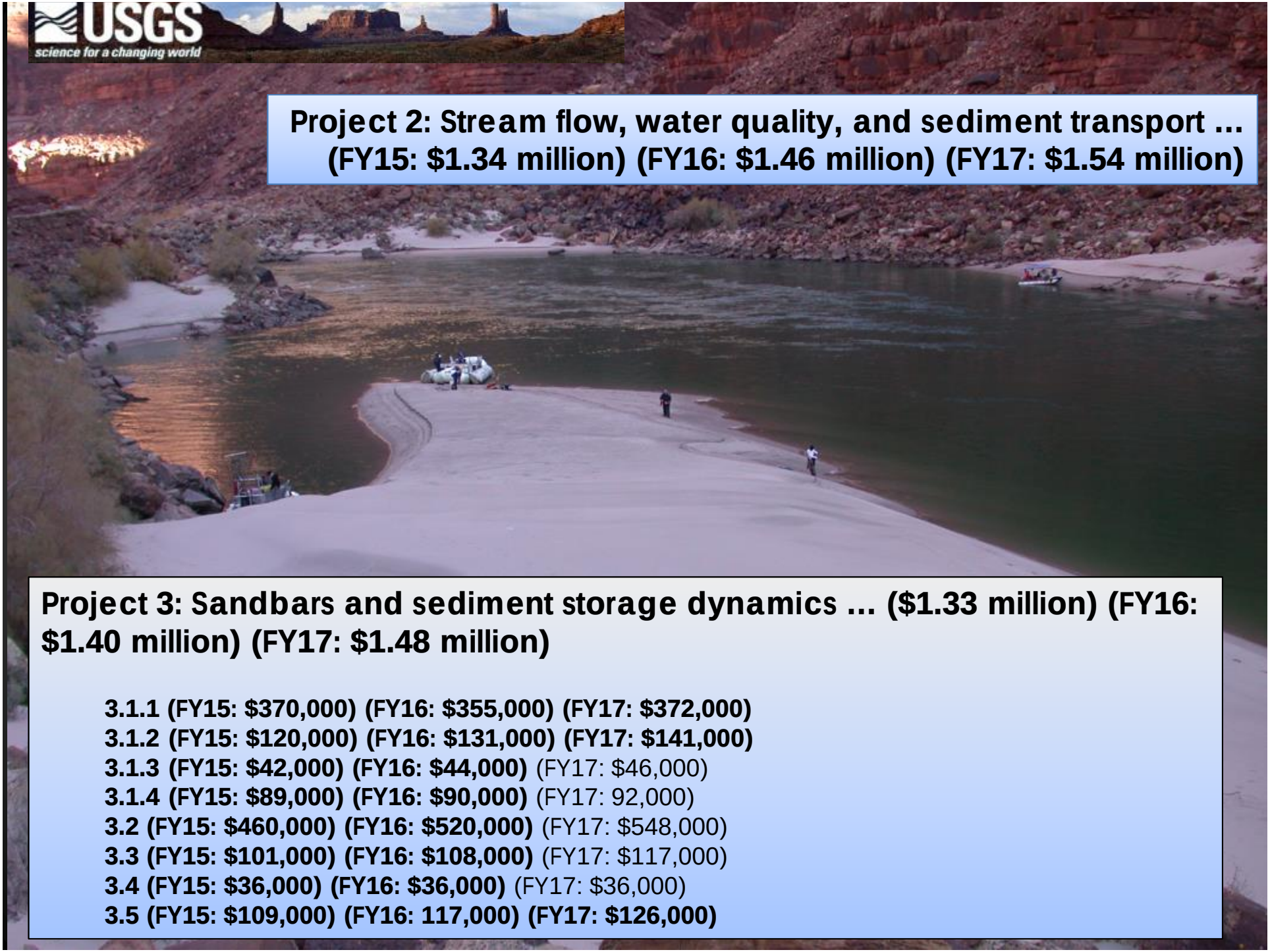




Project 2: Stream flow, water quality, and sediment transport … ($1.34 million)

Project 3: Sandbars and sediment storage dynamics … ($1.33 million)

3.1.1 Monitoring sandbars using topographic surveys and remote cameras ($370,000)
3.1.2 Monitoring sand bars and shorelines…by remote sensing ($120,000)
3.1.3 Surveying with a camera: rapid topographic surveys… ($42,000)
3.1.4 Analysis of historical images at selected monitoring sites ($89,000)
3.2 Sediment storage monitoring ($460,000)
3.3 Characterizing, and predictive modeling, of sand bar response… ($101,000)
3.4 Connecting bed material transport, bed morphodynamics… ($36,000)
3.5 Control network and survey support ($109,000)



Project 2: Stream flow, water quality, and sediment transport … (FY15: $1.34 million) (FY16: $1.46 million) (FY17: $1.54 million)

Project 3: Sandbars and sediment storage dynamics … ($1.33 million) (FY16: $1.40 million) (FY17: $1.48 million)

3.1.1 (FY15: $370,000) (FY16: $355,000) (FY17: $372,000)
3.1.2 (FY15: $120,000) (FY16: $131,000) (FY17: $141,000)
3.1.3 (FY15: $42,000) (FY16: $44,000) (FY17: $46,000)
3.1.4 (FY15: $89,000) (FY16: $90,000) (FY17: 92,000)
3.2 (FY15: $460,000) (FY16: $520,000) (FY17: $548,000)
3.3 (FY15: $101,000) (FY16: $108,000) (FY17: $117,000)
3.4 (FY15: $36,000) (FY16: $36,000) (FY17: $36,000)
3.5 (FY15: $109,000) (FY16: 117,000) (FY17: $126,000)

Project 4: …Quantifying the relative importance of river-related factors that influence upland geomorphology and archaeological site stability ($0.34 million; $0.17 million unfunded)

4.1 Quantifying connectivity along the fluvial-aeolian-hillslope continuum at landscape scales ($138,000 AMP; $75,000 BoR)
4.2 Monitoring of cultural sites in Grand and Glen Canyons ($49,000 AMP; $75,000 BoR; $174,000 unfunded)

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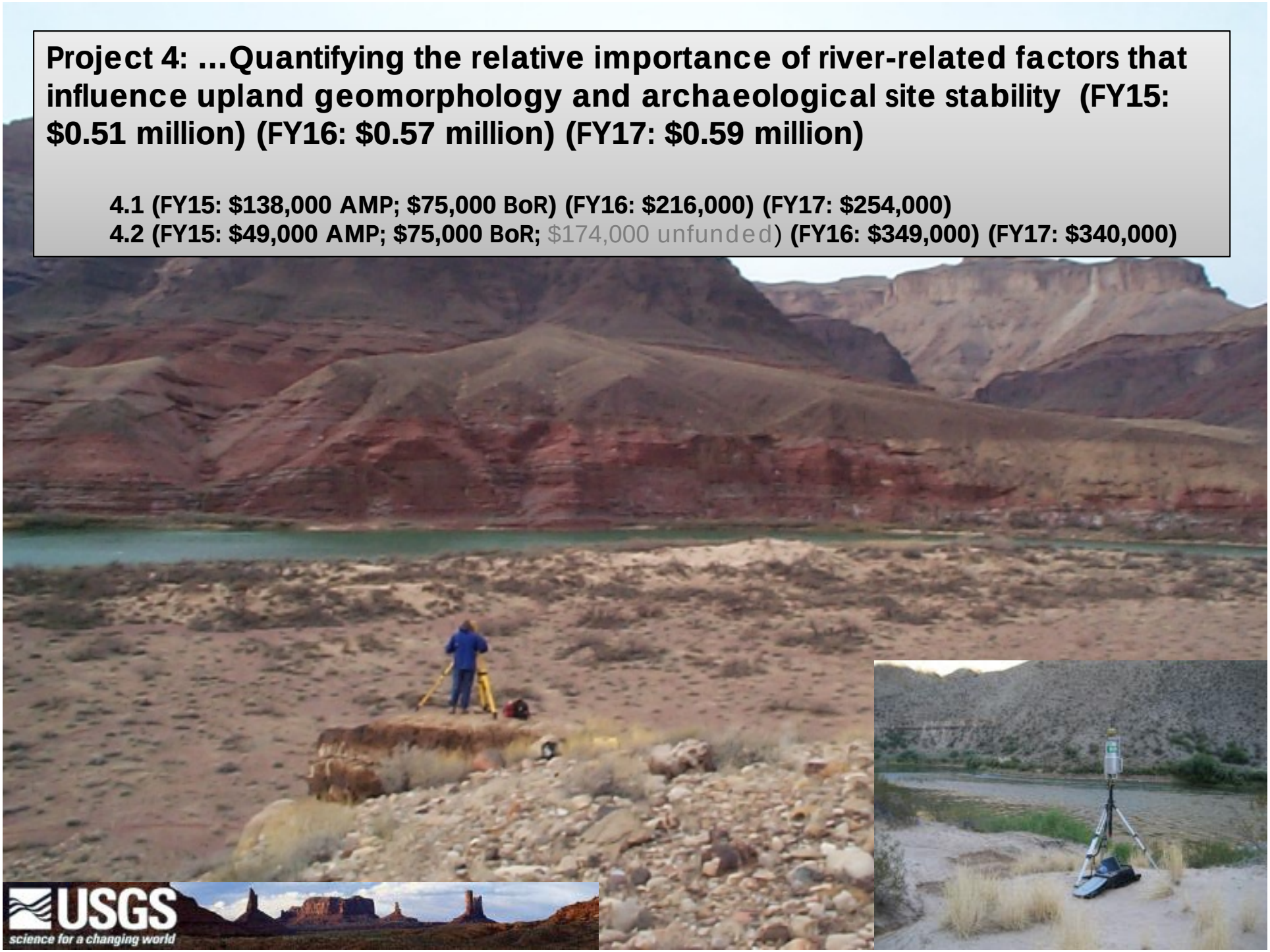
Project 4: …Quantifying the relative importance of river-related factors that influence upland geomorphology and archaeological site stability (FY15: $0.51 million) (FY16: $0.57 million) (FY17: $0.59 million)

4.1 (FY15: $138,000 AMP; $75,000 BoR) (FY16: $216,000) (FY17: $254,000)
4.2 (FY15: $49,000 AMP; $75,000 BoR; $174,000 unfunded) **(FY16: $349,000) (FY17: $340,000)**



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Desired Future Conditions

Native Species -- "Native fish species and their habitats ... sustainably maintained ..."

"A high quality trout fishery in GCNRA ... that does not adversely affect the native aquatic community in GCNP"

Project 5: Food base monitoring and research ($0.52 million; $0.04 million unfunded; $0.23 million request to WAPA for work beyond CRe)

5.1 Are aquatic insect diversity and production recruitment limited?

- 5.1.1 Insect emergence in Grand Canyon via citizen science ($118,000)
- 5.1.2 Effects of hydropeaking on oviposition and egg mortality ($97,000)
- 5.1.3 Synthesis of stressors and controls on EPT distributions ($30,000)
- 5.1.4 Synthesis of the aquatic foodbase in western US tailwaters ($30,000)
- 5.1.5 Natural history of oviposition for species in Grand Canyon ($26,000)
- 5.1.6 Laboratory studies on insect oviposition and egg mortality ($37,000; unfunded)
- 5.1.7 Comparative emergence studies in Upper Basin ($59,000; WAPA)
- 5.1.8 Natural history of oviposition for EPT in the Upper Basin ($25,000; WAPA)

5.2 Patterns and controls of aquatic invertebrate drift in Colorado River tailwaters

- 5.2.1 Characterize and monitor drift, emergence in Glen Canyon ($52,000)
- 5.2.2 Drift monitoring in Glen, Marble, and Grand Canyons ($87,000)
- 5.2.3 Link drift to channel bed shear stress ($21,000)
- 5.2.4 Link drift patterns to substrate in Glen, Marble, Grand Canyons ($21,000)
- 5.2.5 Comparative drift in Upper and Lower Basin tailwaters ($143,000 ;WAPA)

5.3 Primary Production Monitoring in Glen Marble and Grand Canyons

- 5.3.1 Synthesis and publication of Glen Canyon algae production ($26,000
- 5.3.2 Monitoring dissolved O_2 in Glen, Marble, and Grand Canyons ($15,000)
- 5.3.3 Developing automated tools for estimating algae production (outside funding)

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* WAPA: submitted to Western Area Power Administration for funding consideration

Project 5: Food base monitoring and research (FY15: $0.56 million) (FY16: $0.63 million) (FY17: $0.75 million)

5.1 Are aquatic insect diversity and production recruitment limited?

- 5.1.1 **(FY15: $118,000) (FY16: $120,000) (FY17: $139,000)**
- 5.1.2 **(FY15: $97,000) (FY16: 105,000) (FY17: $118,000)**
- 5.1.3 **(FY15: $30,000) (FY16: $32,000) (FY17: $0)**
- 5.1.4 **(FY15: $30,000) (FY16: $32,000) (FY17: $0)**
- 5.1.5 **(FY15: $26,000) (FY16: $28,000) (FY17: $0)**
- 5.1.6 (FY15: $37,000; unfunded) (FY16: $40,000) **(FY17: $47,000)**
- 5.1.7 (FY15: $59,000) (FY16: $64,000) (FY17: $75,000) (WAPA)
- 5.1.8 (FY15: $25,000) (FY16: $28,000) (FY17: $31,000) (WAPA)

5.2 Patterns and controls of aquatic invertebrate drift in Colorado River tailwaters

- 5.2.1 **(FY15: $52,000) (FY16: 67,000) (FY17: $89,000)**
- 5.2.2 **(FY15: $87,000) (FY16: $116,000)** (FY17: $158,000)
- 5.2.3 (**FY15: $21,000) (FY16: 25,000)** (FY17: $30,000)
- 5.2.4 **(FY15: $21,000) (FY16: 25,000)** (FY17: $30,000)
- 5.2.5 (FY15: $143,000) (FY16: $168,000) (FY17: $203,000) (WAPA)

5.3 Primary Production Monitoring in Glen Marble and Grand Canyons

- 5.3.1 **(FY15: $26,000) (FY16: $27,000) (FY17: $0)**
- 5.3.2 **(FY15: $15,000) (FY16: $17,000) (FY17: $18,000)**
- 5.3.3 (FY15-FY17: outside funding)

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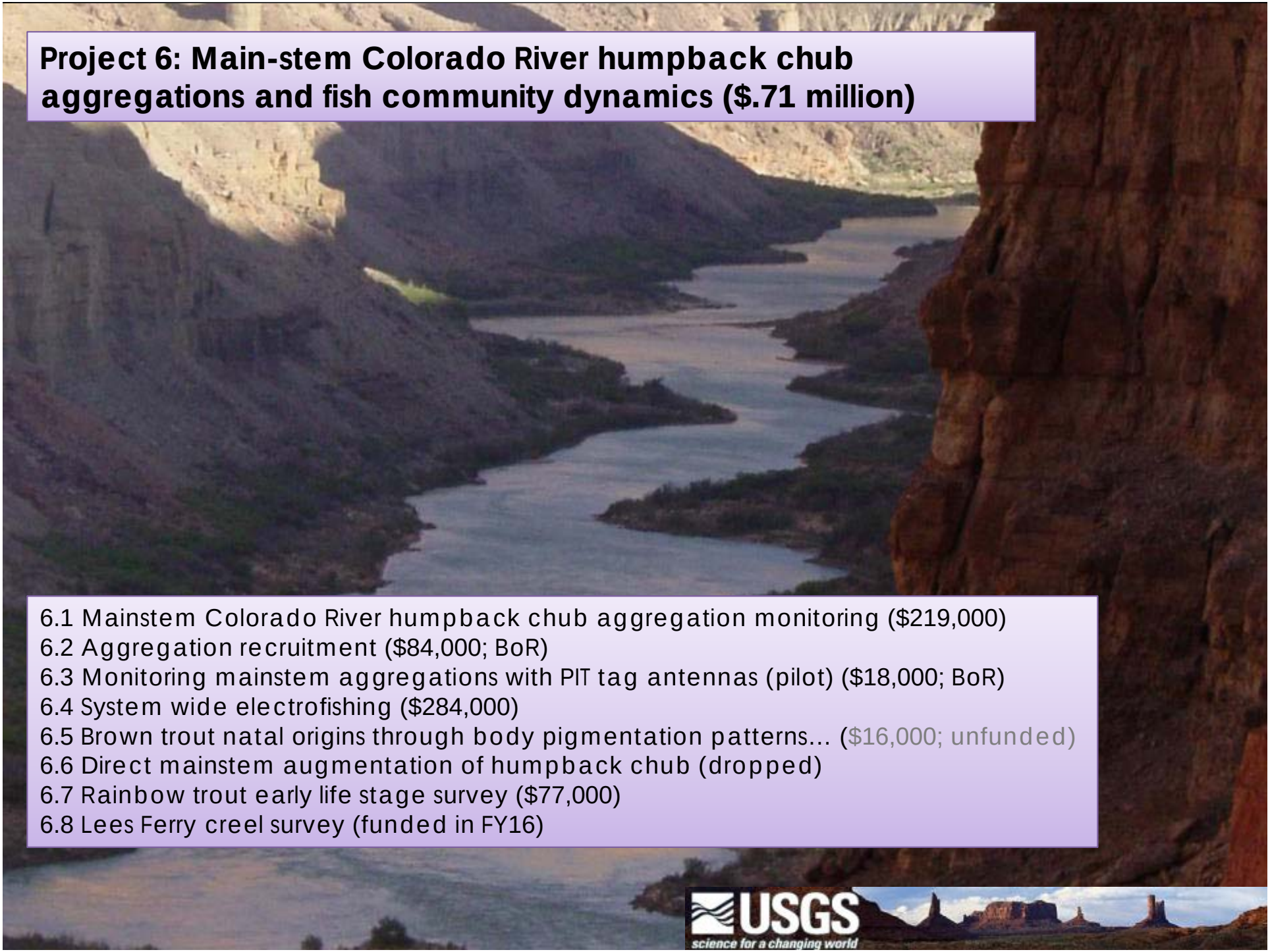
* WAPA: submitted to Western Area Power Administration for funding consideration



Project 6: Main-stem Colorado River humpback chub aggregations and fish community dynamics ($.71 million)

6.1 Mainstem Colorado River humpback chub aggregation monitoring ($219,000)
6.2 Aggregation recruitment ($84,000; BoR)
6.3 Monitoring mainstem aggregations with PIT tag antennas (pilot) ($18,000; BoR)
6.4 System wide electrofishing ($284,000)
6.5 Brown trout natal origins through body pigmentation patterns… ($16,000; unfunded)
6.6 Direct mainstem augmentation of humpback chub (dropped)
6.7 Rainbow trout early life stage survey ($77,000)
6.8 Lees Ferry creel survey (funded in FY16)

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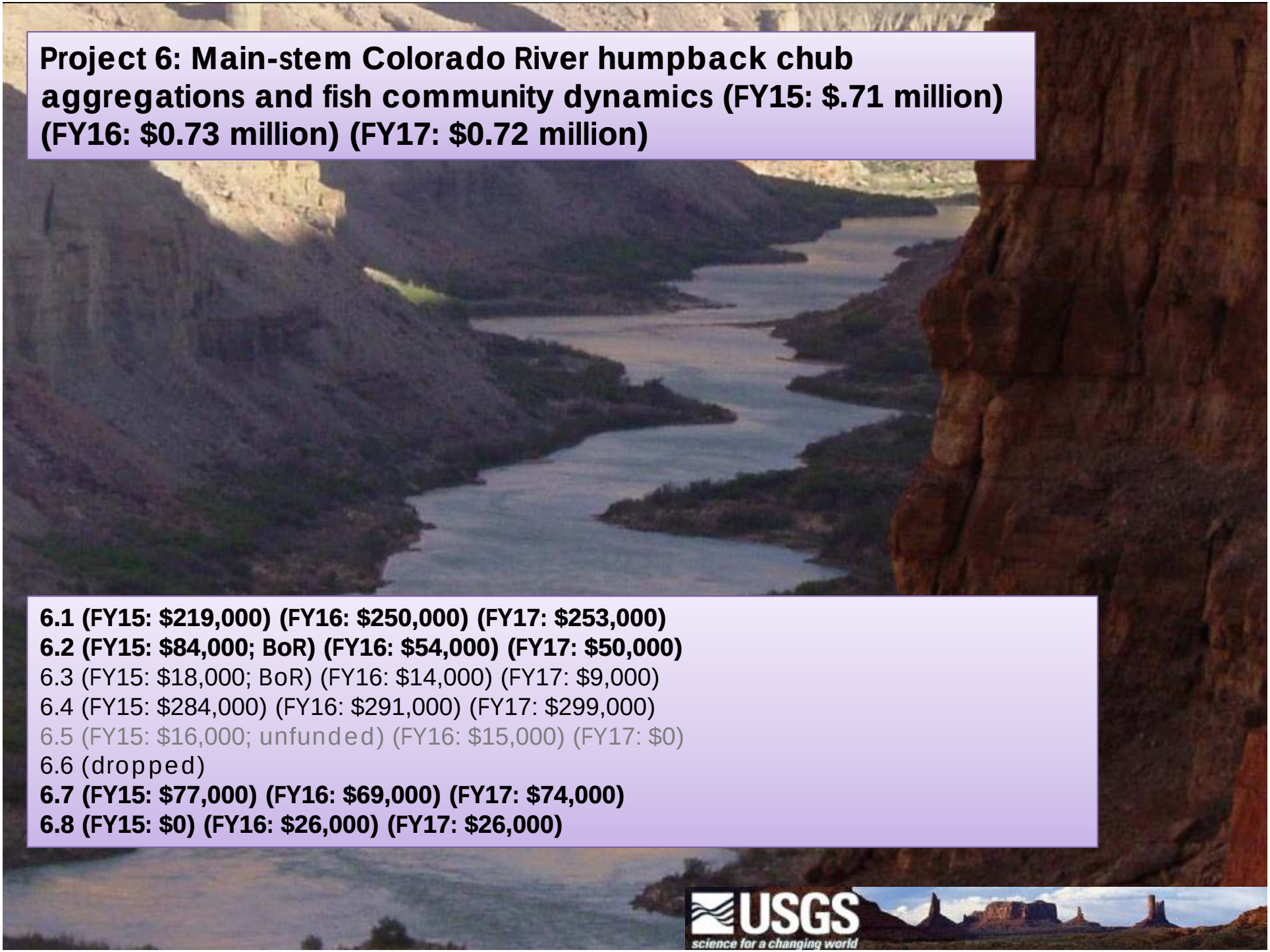

Project 6: Main-stem Colorado River humpback chub aggregations and fish community dynamics (FY15: $.71 million) (FY16: $0.73 million) (FY17: $0.72 million)

6.1 (FY15: $219,000) (FY16: $250,000) (FY17: $253,000)
6.2 (FY15: $84,000; BoR) (FY16: $54,000) (FY17: $50,000)
6.3 (FY15: $18,000; BoR) (FY16: $14,000) (FY17: $9,000)
6.4 (FY15: $284,000) (FY16: $291,000) (FY17: $299,000)
6.5 (FY15: $16,000; unfunded) (FY16: $15,000) (FY17: $0)
6.6 (dropped)
6.7 (FY15: $77,000) (FY16: $69,000) (FY17: $74,000)
6.8 (FY15: $0) (FY16: $26,000) (FY17: $26,000)

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Project 7: Population ecology of humpback chub in and around the Little Colorado River ($1.59 million)

7.1 Spring/fall humpback chub abundance estimates in the LCR ($531,000)
7.2 Juvenile chub monitoring near the LCR confluence ($498,000)
7.3 July LCR juv. humpback chub marking to est. production and outmigration ($112,000; BoR)
7.4 Remote PIT tag array monitoring in the LCR ($54,000)
7.5 Food web monitoring in the LCR ($141,500)
7.6 Gravel substrate limitation for humpback chub reproduction in the LCR ($12,000; (BoR)
7.7 CO_2 as a limiting factor early life history stages of humpback chub in the LCR ($86,000; BoR)
7.8 Evaluate effects of Asian tapeworm infestation on Juvenile humpback chub ($17,000)
7.9 Development of a non-lethal tool to assess physiological condition of HBC… ($42,000; BoR)
7.10 Humpback chub population modeling ($98,000)

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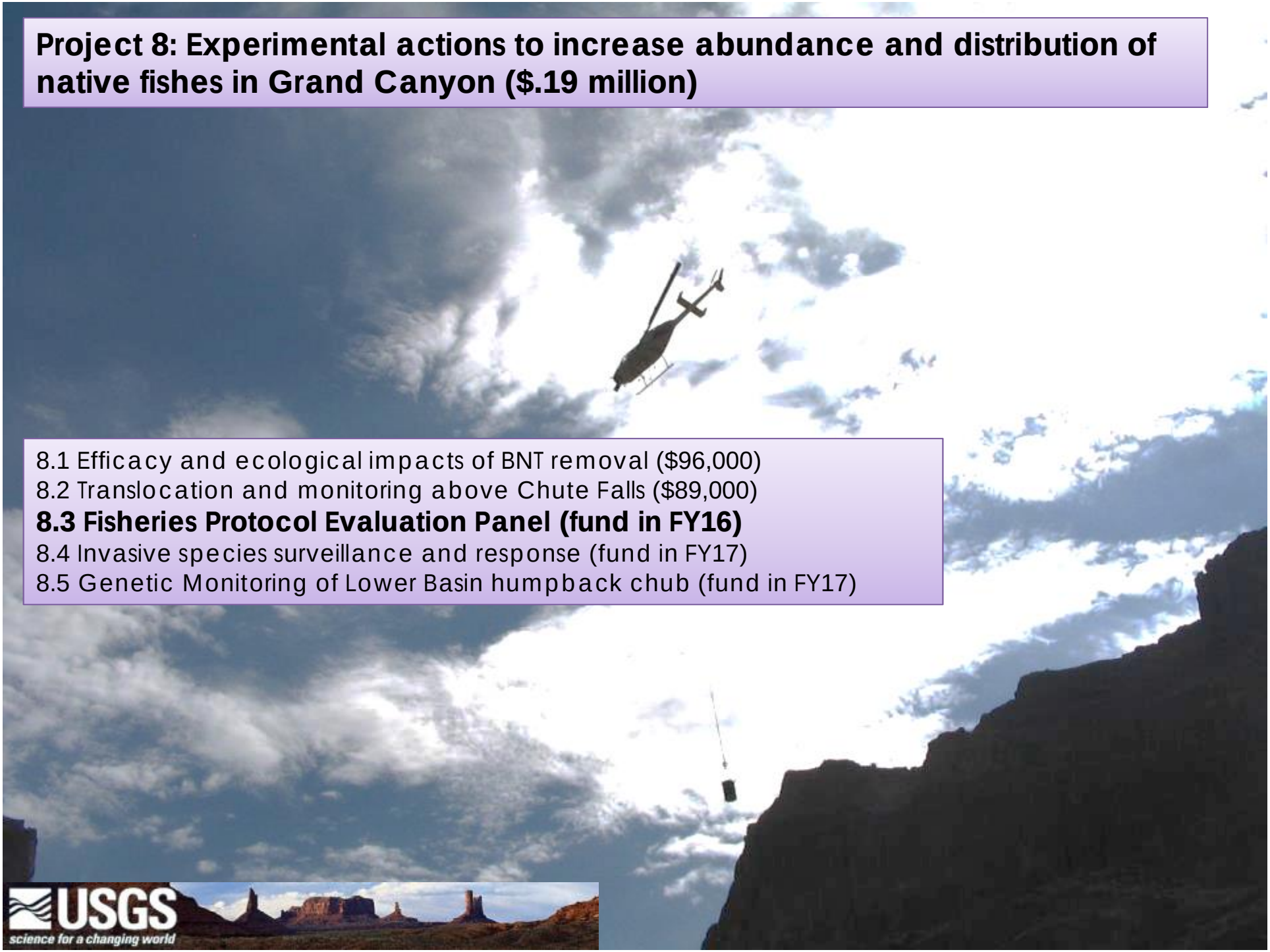
Project 7: Population ecology of humpback chub in and around the Little Colorado River (FY15: $1.59 million) (FY16: $1.75 million) (FY17: $1.47 million)

7.1 (FY15: $531,000) (FY16: $544,000) (FY17: $555,000)
7.2 (FY15: $498,000) (FY16: $516,000) (FY17: $183,000)
7.3 (FY15: $112,000; BoR) (FY16: $113,000) (FY17: $130,000)
7.4 (FY15: $54,000) (FY16: $112,000) (FY17: $142,000)
7.5 (FY15: $142,000) (FY16: $88,000) (FY17: $3,000)
7.6 (FY15: $12,000; BoR) (FY16: $12,000) (FY17: $14,000)
7.7 (FY15: $86,000; BoR) (FY16: $98,000) (FY17: $118,000)
7.8 (FY15: $17,000) (FY16: $17,000) (FY17: $18,000)
7.9 (FY15: $42,000; BoR) (FY16: $96,000) (FY17: $104,000)
7.10 (FY15: $98,000) (FY16: $150,000) (FY17: $204,000)

Project 8: Experimental actions to increase abundance and distribution of native fishes in Grand Canyon ($.19 million)



8.1 Efficacy and ecological impacts of BNT removal ($96,000)
8.2 Translocation and monitoring above Chute Falls ($89,000)
8.3 Fisheries Protocol Evaluation Panel (fund in FY16)
8.4 Invasive species surveillance and response (fund in FY17)
8.5 Genetic Monitoring of Lower Basin humpback chub (fund in FY17)

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Project 8: Experimental actions to increase abundance and distribution of native fishes in Grand Canyon (FY15: $0.19 million) (FY16: $0.21 million) (FY17: $0.29 million)

8.1(FY15: $96,000) (FY16: $119,000) (FY17: $119,000)
8.2 (FY15: $89,000) (FY16: $88,000) (FY17: $88,000)
8.3 (FY15: $0) (FY16: $20,000) (FY17: $0)
8.4 (FY15, 19L $0) (FY17: $52,000)
8.5 (FY15, 16: $0)(FY17: $33,000)

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Project 9: Understanding factors determining recruitment, population size, growth, and movement of rainbow trout in Glen and Marble Canyons ($0.87 million; $0.14 million unfunded)

9.1 Lees Ferry RBT; monitoring, analysis, and study design ($37,000)
9.2 Detection of RBT movement from upper Colorado River below GCD (NO) ($441,000)
9.3 Exploring the mechanisms behind trout growth, reproduction, and movement in Glen and Marble Canyons using lipid (fat) reserves as an indicator of physiological condition ($103,000)
9.4 Comparative study on the feeding morphology of drift feeding fish ($86,420; unfunded)
9.5 Meta-analysis and development of reactive distance relationships… ($20,000; $19,000 unfunded)
9.6 Lab evaluation of turbidity as a management tool to constrain RBT populations and reduce predation/competition on juvenile humpback chub ($37,000)
9.7 Application of a bioenergetics model in a seasonally turbid river ($33,000; $33,000; unfunded)
9.8 Mechanisms that limit RBT and BNT growth in other western tailwater systems ($72,000)
9.9 Contingency planning for HFEs and subsequent RBT population management ($73,000)
9.10 Effects of HFEs on the physiological condition of RBT in Glen Canyon ($54,000)

Project 9: Understanding factors determining recruitment, population size, growth, and movement of rainbow trout in Glen and Marble Canyons (FY15: $1.01 million) (FY16: $1.02 million) (FY17: $0.74 million)

9.1 (FY15: $37,000) (FY16: $76,000) (FY17: $77,000)
9.2 (FY15: $441,000) (FY16: $485,000) (FY17: $372,000)
9.3 (FY15: $103,000) (FY16, 17: $0)
9.4 (FY15: $86,000; unfunded) (FY16: $104,000) (FY17: $93,000)
9.5 (FY15: $20,000; $19,000 unfunded) (FY16: $38,000) (FY17: $0)
9.6 (FY15: $37,000) (FY16: $29,000) (FY17: $30,000)
9.7 (FY15: $33,000; $33,000; unfunded)(FY16: $70,000) (FY17: $67,000)
9.8 (FY15: $72,000) (FY16: $82,000) (FY17: $0)
9.9 (FY15: $73,000) (FY16: $62,000) (FY17: $99,000)
9.10 (FY15: $54,000) (FY16: $70,000) (FY17: $5,000)

Project 10: Where does the Glen Canyon Dam rainbow trout tailwater fishery end? - Integrating Fish and Channel Mapping Data below Glen Canyon Dam ($0.10 million; $0.05 million unfunded)

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Project 10: Where does the Glen Canyon Dam rainbow trout tailwater fishery end? - Integrating Fish and Channel Mapping Data below Glen Canyon Dam (FY15: $0.15 million) (FY16: $0.16 million) (FY17: $0.13 million)

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Project 11: Riparian vegetation studies: ground-based and landscape-scale riparian vegetation monitoring and plant response-guild research associated with sandbar evolution and wildlife habitat analysis (FY15: $0.49 million, AMP; $0.02 SBSC)

11.1 Ground-based vegetation monitoring ($170,000; $6,100 SBSC)
11.2 Periodic landscape scale vegetation mapping and analysis using remotely sensed data ($149,000; $6,000 SBSC)
11.3 Influence of sediment and vegetation feedbacks on the evolution of sandbars in Grand Canyon($94,000; $6,000 SBSC)
11.4 Linking dam ops to changes in terrestrial fauna ($45,000)
11.5 Science review panel of successes and challenges in non-native vegetation control in the Colorado River and Rio Grande watersheds ($31,000;$3,000 SBSC)

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Project 11: Riparian vegetation studies: ground-based and landscape-scale riparian vegetation monitoring and plant response-guild research associated with sandbar evolution and wildlife habitat analysis (FY15: $0.51 million) (FY16: $0.55 million) (FY17: $0.56 million)

11.1 (FY15: $170,000; $6,100 SBSC) (FY16: $192,000) (FY17: $213,000)
11.2 (FY15: $149,000; $6,000 SBSC) (FY16: $128,000) (FY17: $133,000)
11.3 (FY15: $94,000; $6,000 SBSC) (FY16: $98,000) (FY17: $99,000)
11.4 (FY15: $45,000) (FY16: $136,000) (FY17: $110,000)
11.5 (FY15: $31,000; $3,000 SBSC) (FY16,17: $0)

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Project 12: Dam-related effects on the distribution and abundance of selected culturally-important plants in the Colorado River ecosystem

12.1 Tribal workshop and analysis of cultural landscape change ($45,000; $7,000 unfunded)
12.2 Tribal evaluations of cultural landscape changes (unfunded in FY16)

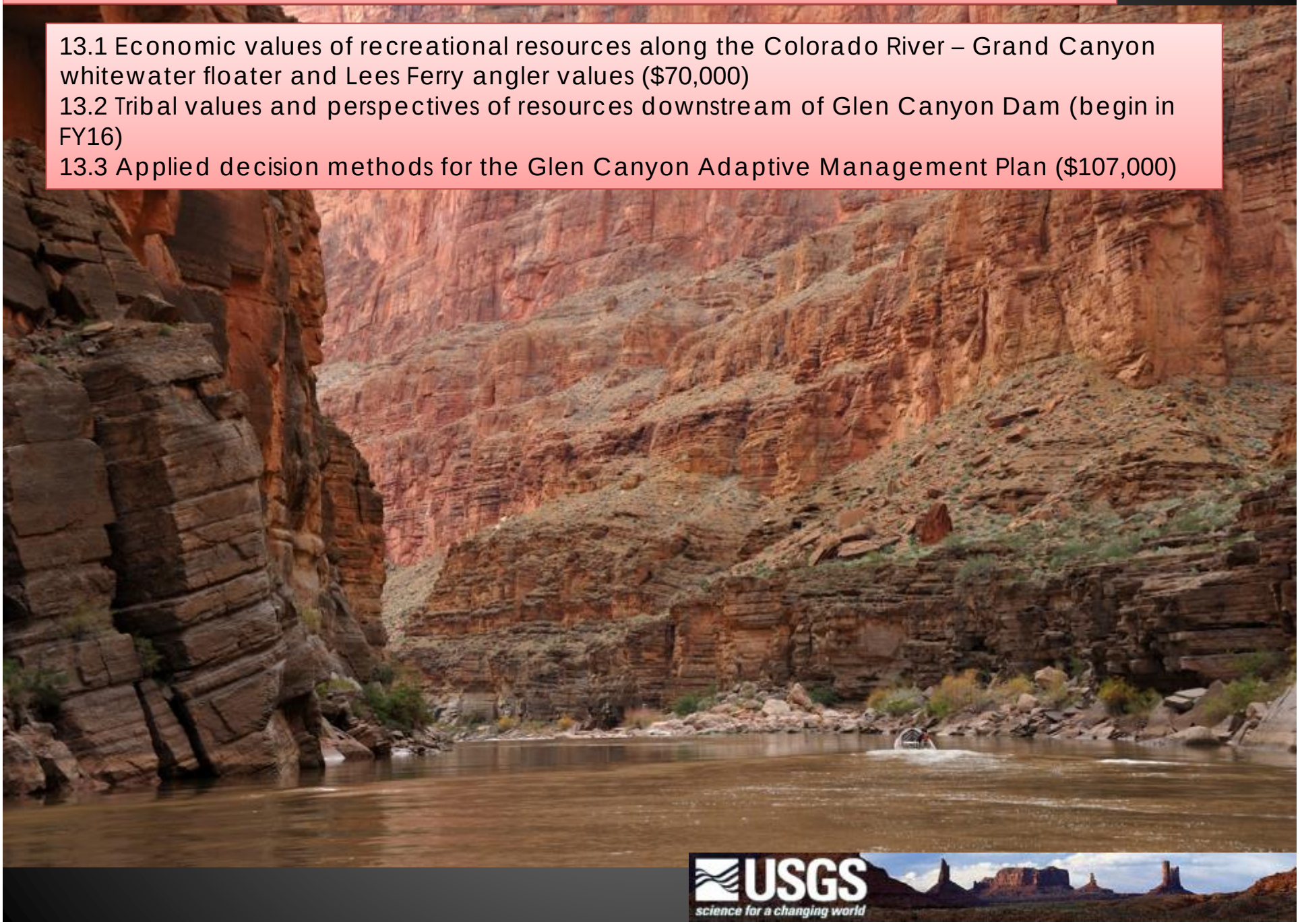
Project 12: Dam-related effects on the distribution and abundance of selected culturally-important plants in the Colorado River ecosystem

12.1 Tribal workshop and analysis of cultural landscape change (**FY15: $45,000**; $7,000 unfunded) **(FY16: $40,000) (FY17: $0**)

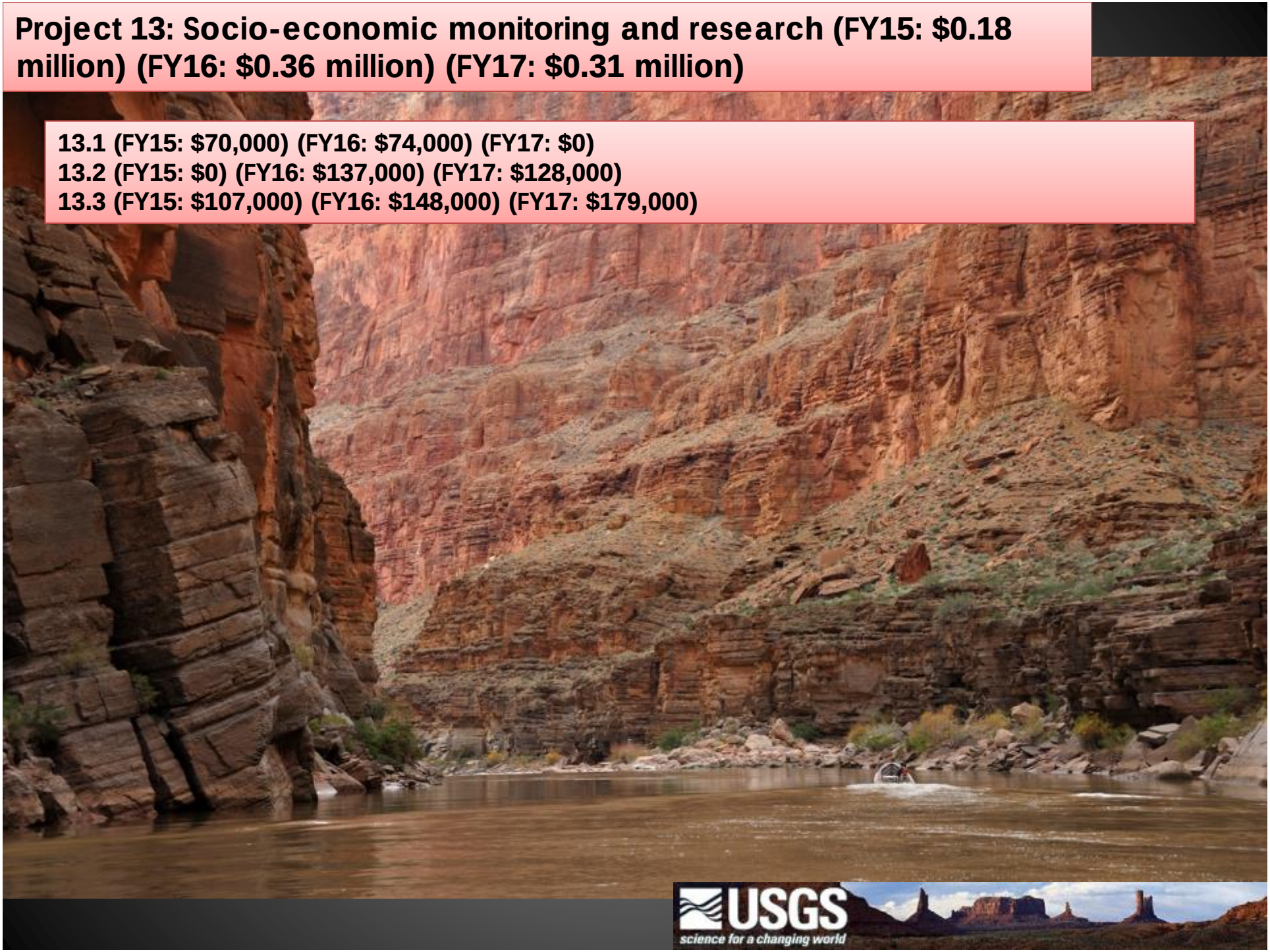
12.2 Tribal evaluations of cultural landscape changes (FY15: $0) (FY16: $46,000) (FY17: $0)

Project 13: Socio-economic monitoring and research ($0.18 million)

13.1 Economic values of recreational resources along the Colorado River – Grand Canyon whitewater floater and Lees Ferry angler values ($70,000)
13.2 Tribal values and perspectives of resources downstream of Glen Canyon Dam (begin in FY16)
13.3 Applied decision methods for the Glen Canyon Adaptive Management Plan ($107,000)



Project 13: Socio-economic monitoring and research (FY15: $0.18 million) (FY16: $0.36 million) (FY17: $0.31 million)



13.1 (FY15: $70,000) (FY16: $74,000) (FY17: $0)
13.2 (FY15: $0) (FY16: $137,000) (FY17: $128,000)
13.3 (FY15: $107,000) (FY16: $148,000) (FY17: $179,000)

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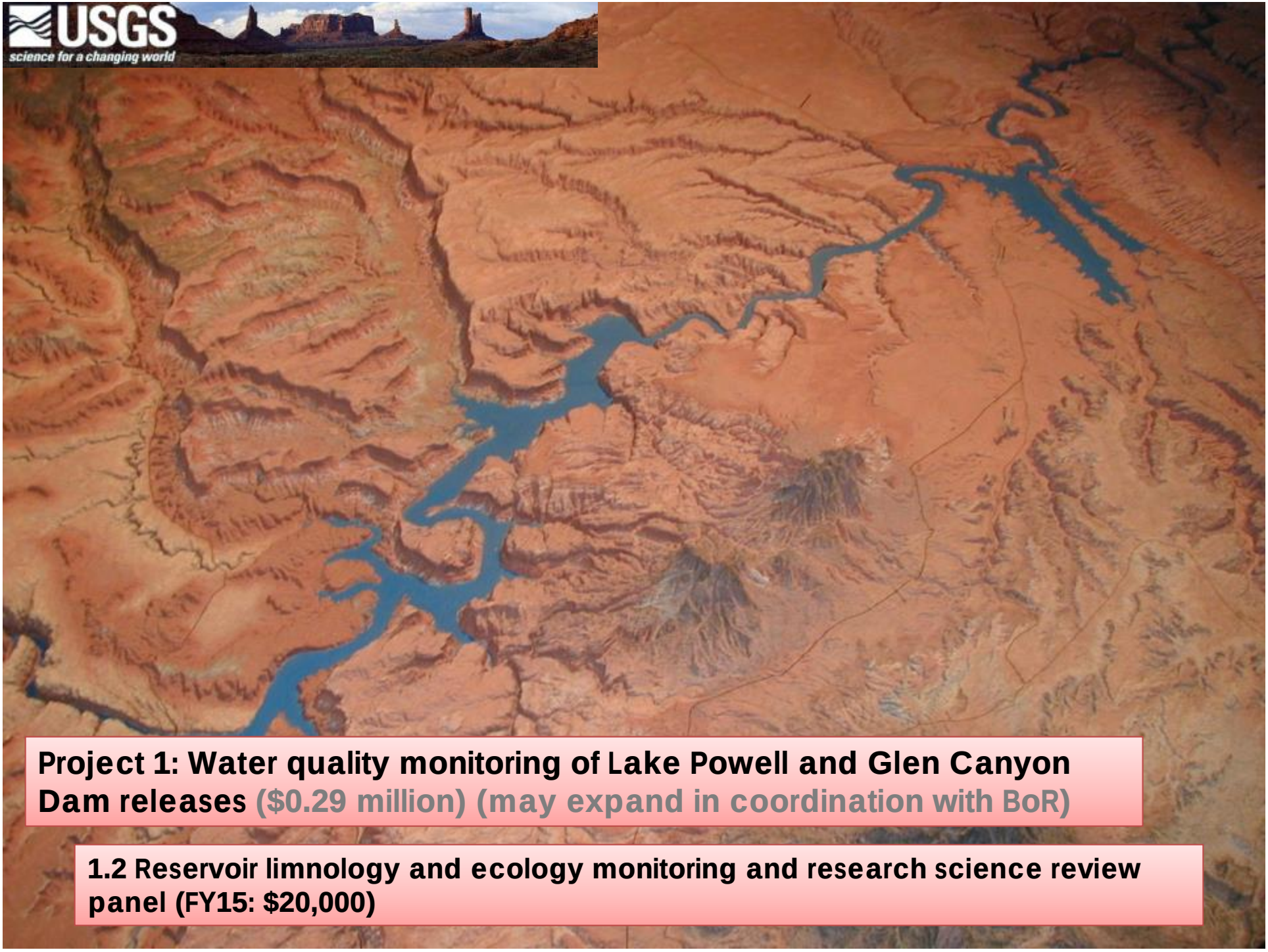
Project 14: Geographic information systems, services, and support (FY15: $0.22 million) (FY16: $0.24 million) (FY17: $0.26 million)

Project 15: Administration and Support (FY15: $1.35 million) (FY16: $1.44 million) (FY17: $1.56 million)



Project 1: Water quality monitoring of Lake Powell and Glen Canyon Dam releases ($0.29 million) (may expand in coordination with BoR)

1.2 Reservoir limnology and ecology monitoring and research science review panel (FY15: $20,000)

GCMRC FY13, FY14, and FY15 Budget Comparison

FY	Salaries	Travel & Training	Operating Expenses	Logistics	Contractors	Cooperators (non-USGS)	USGS Cooperators	USGS Burden	Total
2013	$4,203,186	$187,515	$686,314	$1,002,000	$739,600	$1,741,900	$1,024,684	$855,401	$10,440,600
2014	$4,652,954	$183,900	$670,903	$973,600	$186,788	$1,776,600	$1,062,000	$1,011,655	$10,518,400
2015	$4,734,025	$149,000	$815,048	$807,924	$0	$1,964,049	$658,794	$1,099,881	$10,228,721