Table 1. Summary table of FY 2002, project titles and associated management objectives and information needs.

PROJECT TITLE	MANAGEMENT OBJECTIVE	INFORMATION NEED
TERRESTRIAL ECOSYSTEM ACTIVITIES		
Terrestrial ecosystem monitoring (combined with avifaunal monitoring)	**TERR MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved. **AVI MO 13:** Protect, restore, and enhance survival of native and special status avifauna. **MO 16:** Maintain, enhance or restore vegetative communities made up of diverse groups of native riparian and upland species with special emphasis on preservation of unique plant communities and special status species at different stages of succession and at different elevations above the water line.	IN 11.1 Define and specify ecology of native faunal components, especially threatened and endangered species; including evolutionary and environmental changes, natural range of variation, linkages, interdependencies, and requirements. TERR IN 11.2 Determine species population characteristics to detect departures from natural range of variation. TERR IN 11.3 Determine changes, declines in special status species and characterize ecosystem changes to benefit species. AVI IN 13.2 Determine impacts of dam operations under approved operating criteria on avifauna food chain associations IN 16.1 Determine distribution and abundance of native and non-native riparian and upland vegetation, including federal-, state- and tribal-listed sensitive species, old high water zone, new high water zone, and nearshore marshes IN 16.3 Determine change in extent or abundance of the OHWZ and NHWZ plant communities. Link monitoring to site specific studies to

		determine species diversity.
Monitoring Kanab ambersnail and habitat at Vaseys Paradise	**KAS MO 14:** Sustain populations of Kanab ambersnail wherever they currently exist within the Colorado River ecosystem.	KAS IN 14.1 Determine specific habitat characteristics required by the KAS. (T&C 3--p.41) KAS IN 14.2 Determine special flow impacts on Kanab ambersnail to assure that the level of incidental take is not exceeded. (I. T. - p.40) KAS IN 14.3 Complete a census of the population and characterize the habitat. Once habitat require-ments are determined, other potential habitat sites within the Grand Canyon corridor will be surveyed to determine species presence and recovery potential. (Conservation Recommendation 5--p.43) KAS IN 14.4 Survey KAS habitat before and after any flow greater than 25,000 cfs to determine population and its species response to disturbance and ability to recover. (T&C 4, p.42; and RPM) KAS IN 14.5 Determine Kanab Ambersnail life history schedule for populations in the Colorado River ecosystem. (Conservation Recommendation 5)
Terrestrial habitat mapping	**MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved.	IN 11.5 Develop a comprehensive wildlife habitat map (using remote sensing and GIS) for the river corridor for high priority species (mammals, amphibians, reptiles, birds).
New terrestrial	**AVI MO 13:** Protect, restore, and	IN 13.2 Determine impacts of

research (carbon budget linked to aquatics) or may be folded into terrestrial monitoring funding	enhance survival of native and special status avifauna.	dam operations under approved operating criteria on avifauna food chain associations.
Mapping Holocene Terrace Deposits **NEW RFP IN 2002**	**CULT MO 1:** Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem. **CULT MO 2:** If *in situ* conservation is not possible, design mitigative strategies that integrate the full consideration of the values of all concerned tribes with a scientific approach	CULT IN 1.1 Monitor cultural sites potentially impacted by Glen Canyon Dam operations to determine present condition and rate of change to assess: types of degradation, threats; rates of degradation; define immediacy of threats to resources; protection methodologies; protection, monitoring and research costs. CULT IN 2.1 Characterize through scientific study and data development all assumed historical and current values, including scientific values, of resources to tribal nations and to the general public.
Long –Term Monitoring Plan **NEW RFP IN 2002**	**CULT MO 1:** Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem. **CULT MO 2:** If *in situ* conservation is not possible, design mitigative strategies that integrate the full consideration of the values of all concerned tribes with a scientific approach	CULT IN 1.1 Monitor cultural sites potentially impacted by Glen Canyon Dam operations to determine present condition and rate of change to assess: types of degradation, threats; rates of degradation; define immediacy of threats to resources; protection methodologies; protection, monitoring and research costs. CULT IN 2.1 Characterize through scientific study and data development all assumed historical and current values, including scientific values, of resources to tribal nations and to the general public.

Data Base Plan **ONGOING RFP IN 2002**	**CULT MO 4:** Maintain and integrate all appropriate cultural data recovered from monitoring, remedial, and mitigative action and incorporate these data into the evolving research designs and mitigative strategies for understanding the human occupation and use of the Colorado River ecosystem.	CULT IN 4.1 Develop evolving research designs and/or other methods including synthesis of existing available data and GIS for understanding human occupation and use.

AQUATIC ECOSYSTEM ACTIVITIES		
Monitoring phyto-benthic community and evaluating its quality for utilization New RFP for 2002	**AFB MO 1:** Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.1 Determine status and trends in aquatic food base species composition and population structure, density and distribution and the influence of ecologically significant processes. AFB IN 1.2 Determine the effects of past, present, and future dam operations under the approved operations criteria on the aquatic food base species composition, population structure, density, and distribution in the Colorado River ecosystem. AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem. HBC IN 3/4.7 Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources. (RPM 1.C.vi) Evaluate linkages between the aquatic food base and the health and sustainability of HBC populations.

Monitoring of status and trends of fish community **New RFP for 2002**	**HBC MO 4:** Maintain or enhance levels of recruitment of HBC in the mainstem as indexed by size frequency distributions and presence and strength of year-classes. (Focused at young-of-year and juvenile fish, and should include a fish health assessment.) **FMS MO 8:** Achieve healthy, self-sustaining populations of flannelmouth sucker, bluehead sucker, and speckled dace in the Colorado River ecosystem, with special emphasis on flannelmouth sucker in Glen Canyon based upon the capability of the habitat to support those fishes.	HBC IN 3/4.1 Determine adult HBC populations and evaluate life history schedules, population health, and reproductive success. *(Fall 97 RPM 1)* HBC IN 3/4.2 Determine levels of recruitment of humpback chub in the mainstem and the LCR. FMS IN 8.2 Determine population dynamics, distribution, and other life history traits of native fish species. FMS IN 8.3 Determine historic and current character and structure of native fish populations.
Monitoring the status and trends of the Lees Ferry Trout Fishery **Continued from 2001**	**TROUT MO 2:** In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, foodbase and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.2 Determine trends in rainbow trout population size, character and structure in Glen Canyon. TROUT IN 2.3 Evaluate harvested and field sampled rainbow trout to determine the contribution of naturally reproduced fish to the population in Glen Canyon.

Integrated Water Quality Monitoring **ONGOING WITH REVISION AND COOPERATION BETWEEN GCMRC AND USGS (WRD AZ DISTRICT)**	**LP WQ MO 1:** Prevent impacts that adversely affect the water quality (physical, chemical, biological) of Lake Powell due to dam operations and ensure that fully informed AMWG decisions are possible both now and in the future.	LP-LIMNO IN 1.1 Determine the effect of current dam operations (under approved operating criteria) on reservoir water quality, including but not limited to the following: (a) Determine near dam hydrogen sulfide levels (and other hazardous chemical constituents) within the hypolimnion occurring under current dam operating criteria. (b) Determine the dynamics of lake stratification and advective flows and their effects on chemical constituents (c) Determine/quantify the dynamics of major cations, anions, and nitrate/phosphate ratios resulting from dam operations (d) Determine the effects of dam operations (under approved operating criteria) on the physical/chemical dynamics of Lake Powell side channels and embayments LP-BIO IN 1.1 Determine the impacts of dam operations and resulting water quality on primary and secondary productivity of Lake

	WATER MO 2: (water resources) Maintain water quality at levels appropriate to support physical, biotic, and human resource needs…	Powell, including: • algae (phytoplankton, periphyton) • Macrophytes • Zooplankton WATER IN 2.1 Monitor water quality, composition, tempera-ture (a more comprehensive list of the INs that are addressed by the IWQP can be seen in Table 1 of the IWQP plan (Vernieu and Hueftle, 1999).
Fishery research Bioenergetic model for Lees Ferry **NEW IN SPRING 2002**	**MO 2:** In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, foodbase and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	IN 2.7 Determine the trophic relationship between trout and the aquatic food base including the size of the aquatic food base required to sustain the desired trout population in Glen Canyon.

INTEGRATED TERRESTRIAL AND AQUATIC ECOSYSTEM ACTIVITIES		
Long-term monitoring of fine-grained sediment storage throughout the main channel **NEW RFP IN SPRING 2000**	**SED MO 1:** (sediment resources) Maintain a long-term balance of river-stored sand to support maintenance flow, BHBF flow and unscheduled flood flows…	SED IN 1.1 Define historical and current levels of river stored sediment. SED IN 1.2 Define minimum levels of river stored sediments necessary to maintain sandbars, backwaters and in-stream sediment deposits. SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources. SED IN 1.5 (sediment) Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment. SED IN 2.4 Evaluation of flow

	SED MO 2: As a minimum for each reach, maintain the number and average size (area and thickness) of sandbars and backwaters between the stages associated with flows of 8,000 and 45,000 cfs that existed during the 1990/91 research flows.	regime (under the approved operating criteria) impacts on terrace and cultural resources SED IN 2.6 Determine implications of dam operating criteria on beach and sandbar and backwater character and structure, including suitability of camping beaches. SED IN 2.7 Quantify the extent and location of existing sandbars, beaches and backwaters along the Colorado River corridor SED IN 4.1 Define character and structure of all beaches and backwaters in system after 1996 test flows
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met. **REC MO 2:** Maintain flows (under approved operating criteria) and sediment processes that create an adequate quantity, distribution and variety of beaches for camping, as long as such flows are consistent with management of natural recreation and cultural resource values (other natural resource values).	REC IN 2.2 Evaluate impacts of operating criteria on establishing and maintaining adequate beaches and distribution of other resources, quality, character and structure. REC IN 2.3 Develop methodology to evaluate distribution, quantity and quality changes in all campable beaches through time
	AFB MO 1: Maintain and enhance the aquatic food base in the Colorado River	AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required

	ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam. **TROUT MO 2:** In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, food base and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90. **HBC MO 4:** Maintain or enhance levels of recruitment of HBC in the mainstem as indexed by size frequency distributions and presence and strength of year-classes. (Focused at young-of-year and juvenile fish, and should include a fish health assessment.)	to maintain desired populations of native and non-native fish in the Colorado River ecosystem. TROUT IN 2.4 Determine the availability and quality of spawning substrates in the Glen Canyon reach, necessary to sustain the rainbow trout fishery. HBC IN 3/4.5 Determine the effects of mainstem hydrology on the number of nearshore rearing habitats, environmental conditions in these habitats, and their successful utilization by HBC. (RPM 1.C.iii) HBC IN 3/4.8 Determine effects on physical habitat used by young fishes, food base, and direct effect on larval, juvenile, and adult native and non-native fishes of 1996 BHBF. Develop methods to detect changes in numbers of HBC or their habitat from 1996 BHBF. (1996 BHBF HBC RPM 3) CULT IN 1.4 Preservation, stabilization and/or documentation

	CULT MO 1: Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem.	stabilization and/or documentation of cultural resources as impacted by sediment resources associated with alternative operating criteria CULT IN 1.5 Preservation, stabilization of flood terraces holding cultural resources CULT IN 1.6 Evaluate flood terrace stability necessary to maintain cultural resources and terraces at pre-dam conditions

Long-term Streamflow and fine sediment transport in the main channel Colorado, Paria and Little Colorado Rivers **ONGOING WITH REVISION THROUGH SOLE SOURCE TO USGS (WRD AZ DISTRICT)**	**WATER MO 1:** …Operate GCD in a manner fully consistent with the ROD and subject to the "Law of the River"… **WATER MO 2**: Maintain water quality at levels appropriate to support physical, biotic, and human resource needs of various ecosystems downstream of Glen Canyon Dam as mandated by the Grand Canyon Protection Act and incorporated into the Record of Decision. **SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	WATER IN 1.1 Annually collect and report GCD flow release information. WATER IN 2.1 Characterize sandbar/backwater baselines and character and structure in 1990/1991 WATER IN 2.2 Working with various resource agencies and specialists, select most appropriate flow levels/regimes under the approved operating criteria to determine baseline for comparisons for all resources. SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources SED IN 1.5 Evaluate the geology/geomorphology within

		Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment.
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met	SED IN 4.2 Develop methodologies to define future flow regimes under approved operating criteria to maximize benefit to sediment and backwater character and structure SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges
	REC MO 4: Maintain flows (under approved operating criteria) and habitat suitable for quality cold water fishery opportunities in Glen Canyon.	REC IN 4.1 Determine flow regimes (under approved operating criteria) necessary to maintain fish populations of 100,000 adult Trout (age class II plus)

Long-term monitoring of coarse-sediment inputs, storage and impacts to physical habitats **NEW RFP IN SPRING 2000**	**REC MO 1:** Provide quality recreation experiences consistent with other resource objectives.	REC IN 1.1 Determine criteria and aspects that are important to or detract from recreational experience.
	SED MO 1: Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources
	AFB MO 1: Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem.
	TROUT MO 2: In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, food base and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.4 Determine the availability and quality of spawning substrates in the Glen Canyon reach, necessary to sustain the rainbow trout fishery.
	FMS MO 8: Achieve healthy, self-sustaining populations of flannelmouth	FMS IN 8.4 Determine historic

	sucker, bluehead sucker, and speckled dace in the Colorado River ecosystem, with special emphasis on flannelmouth sucker in Glen Canyon based upon the capability of the habitat to support those fishes. **TERR MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved. **VEG MO 16:** Maintain, enhance or restore vegetative communities made up of diverse groups of native riparian and upland species with special emphasis on preservation of unique plant communities and special status species at different stages of succession and at different elevations above the water line.	and current ecosystem requirements (habitat, spacing, food source, interdependencies, etc.) of native fish species. TERR IN 11.4 Identify and characterize riparian wildlife habitat types along the river corridor VEG IN 16.1 Determine distribution and abundance of native and non-native riparian and upland vegetation, including federal-, state- and tribal-listed sensitive species, old high water zone, new high water zone, and nearshore marshes
Modeling reach-averaged sandbar evolution in response to discharge and sediment conditions **NEW RFP FOR SPRING 2000**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and

		backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment.
	SED MO 2: As a minimum for each reach, maintain the number and average size (area and thickness) of sandbars and backwaters between the stages associated with flows of 8,000 and 45,000 cfs that existed during the 1990/91 research flows.	SED IN 2.4 Evaluation of flow regime (under the approved operating criteria) impacts on terrace and cultural resources
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met.	SED IN 4.2 Develop methodologies to define future flow regimes under approved operating criteria to maximize benefit to sediment and backwater character and structure SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges

Development of one-dimensional fine sediment routing model along the main channel **NEW RFP FOR SPRING 2000**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/ habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment

Advance conceptual modeling of coarse-grained sediments related to evolving physical habitats and aquatic processes **ONGOING WITH REVISION THROUGH ECOMETRIC RESEARCH (KORMAN, ET. AL.)**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity. **SED MO 4:** Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met. **REC MO 2:** Maintain flows (under approved operating criteria) and sediment processes that create an adequate quantity, distribution and variety of beaches for camping, as long as such flows are consistent with management of natural recreation and cultural resource values (other natural resource values).	SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources. SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment. SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges REC IN 2.1 Determine adequate beach quantity, quality, distribution, character and structure for camping throughout system. REC IN 2.2 Evaluate impacts of operating criteria on establishing and maintaining adequate beaches and distribution of other resources, quality, character and structure.
Evaluating ground-based and airborne	**GIS MO 1:** Creation of GIS base coverages in support of integrated monitoring efforts.	GIS IN 1.1 Develop a comprehensive GIS base map for topography, geology and soils for

remote sensing technologies		the Colorado River ecosystem
IT/GIS development	**GIS MO 1:** Creation of GIS base coverages in support of integrated monitoring efforts	GIS IN 1.1 Develop a comprehensive GIS base map for topography, geology and soils for the Colorado River ecosystem