

## SEC Member Question/Comment Tracking Log Updated 05.27.2020

ID #	Date	Commenter	Questions/Comments	Response	Responder	Date Responded	Response Status
2.17	12/11/19	Anna Swenson	How long the bridges have to be up and when for DCA construction barges?	There are two bridges on one of the potential barge routes (from West Sacramento to either barge landing) including the Rio Vista Bridge and Three Mile Slough Bridge. The operations timing of the bridge would be dependent on the specific bridge, river conditions and barge configuration, and is estimated to be 15 to 30 minutes at each bridge.	Jim Lorenzen	5/27/2020	Responded
2.18	12/11/19	Anna Swenson	What are round trip barge calculations?	This would be dependent on the port location, specific route, river conditions (including tide, flow, and wind), and barge configuration. For example, for the route between the Port of Stockton and Bouldin Island (a one-way route of 17 nautical miles), under ideal river conditions, the barge cycle could be completed in approximately 8 hours with 1 hour to load at the port, 2 hours transit to Bouldin Island, 2 hours to return to the port, and 1 hour to moor at the port.	Jim Lorenzen	5/27/2020	Responded
2.21	12/11/19	Anna Swenson	What are the fuel stations aesthetics? Whether they will be temporary or permanent, if they will be underground or above-ground tanks, their proximity to schools and people and what safety operations are going to be used to ensure against contamination?	As currently proposed, fuel tanks would be located at the larger construction sites, including intakes, larger tunnel shaft sites, and the Southern Complex. During construction, the fuel tanks would be installed within security fences and would be above ground structures surrounded by lined spill-prevention facilities. During operations, fuel tanks would likely need to be located at the intakes and pumping plant for emergency engine generators. These fuel tanks also would be located above-ground within security fencing and lined spill-prevention facilities to protect surface water and groundwater. The fuel tanks would not be located within the high-water mark of any on-site or adjacent drainages. All fuel facilities would require permitting by the Regional Water Quality Control Board.	Jim Lorenzen	5/27/2020	Responded
2.22	12/11/19	Anna Swenson	What are the batch plants' effects on air quality?	Dust issues at batch plants primarily occur as the dry ingredients are mixed together prior to the addition of water to make the concrete, slurry, or grout. The batch plants would be required to install the equipment that receives and mixes the dry ingredients within a shelter that includes large fans and air filtration equipment to minimize particulate matter (dust) from leaving the construction site. DWR will complete a full analysis of the potential effects on air quality and potential mitigation measures as part of the California Environmental Quality Act (CEQA) compliance effort.	Gwen Buchholz	5/27/2020	Responded
2.23	12/11/19	Anna Swenson	Request for a map that depicts an interaction with the bridges.	Related to barge routes, the only bridges along the potential barge routes would be the Rio Vista Bridge and Three Mile Slough bridge for goods delivered from the Port of West Sacramento. No bridges would be crossed for goods delivered from the Port of Stockton or Port of Antioch. Goods delivered from ports along San Francisco and San Pablo Bays would need to pass under the Carquinez and Benicia railroad bridges.  Related to roadway routes, several bridges could require modification depending upon the final roadway options, as are shown in the map books. No railway bridges would be affected by the construction; however, another bridge would be constructed adjacent to the railway bridge across the California Aqueduct and a roadway overcrossing would be constructed over the railway bridge near Holt, California.	Jim Lorenzen	5/27/2020	Responded
2.25	12/11/19	Anna Swenson	Barges: Size, docking areas, bridges impact, how many barge trips per day, how many docks for barges?	There is currently only one barge landing for the Central Corridor at Bouldin Island and one barge landing for the Eastern Corridor at Lower Roberts Island. Each barge landing would be approximately 1,200 feet long along the bank of the river or slough and would be constructed into the existing levee to minimize extension into the waterway. The number of barge trips per day would depend upon the goods to be barged and the source location (e.g., Port of Stockton, Port of West Sacramento, Port of Antioch).	Jim Lorenzen	5/27/2020	Responded

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2.26	12/11/19	Barbara Barrigan-Parrilla	What is the toxicity from soil strengthening, potential spread and impact on sloughs?	Ground improvement to strengthen the structural foundation of the soils would likely consist of a combination of excavation of unsuitable soils (such as peat soils), placement of compacted suitable and clean fill material to induce consolidation prior to final construction, and mechanically mixing of cement or similar materials to add soil strength. None of these actions would result in introduction of contaminants to the soil or groundwater aquifer.	Andrew Finney	5/27/2020	Responded
2.27	12/11/19	Barbara Barrigan-Parrilla	Air quality around port of Stockton from increased barge and train traffic?	DWR will analyze potential air quality impacts and mitigation as part of the EIR preparation.	Gwen Buchholz	5/27/2020	Responded
2.28	12/11/19	David Gloski	What are the anticipated waterway rules and process when DCA construction barges are on the waterways?	Barge traffic along the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel would operate in accordance with the requirements of the U.S. Army Corps of Engineers and the Port of West Sacramento and Port of Stockton, respectively. In addition, the barges and the associated tugboats would operate in accordance with requirements of the U.S. Coast Guard and the Division of Boating and Waterways of the California Department of Parks and Recreation. Notifications would be provided to the U.S. Coast Guard and local marinas.	Jim Lorenzen	5/27/2020	Responded
2.32	12/11/19	Gilbert Cosio	Specific discussions about the barge loading locations	The Central Corridor currently includes a barge landing for Bouldin Island along Potato Slough. The Eastern Corridor currently includes one barge landing for Lower Roberts Island along the San Joaquin River/Stockton Deep Water Ship Channel.	Jim Lorenzen	5/27/2020	Responded
2.34	12/11/19	Karen Mann	How barges used by DCA during construction would affect the recreational activities in the waterways	DWR will evaluate the potential effects of barge traffic and recreational navigation activities in the waterways as part of the EIR preparation.	Jim Lorenzen	5/27/2020	Responded
2.35	12/11/19	Karen Mann	Waterways safety and usage during construction barging	Barge traffic along the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel would operate in accordance with the requirements of the U.S. Army Corps of Engineers and the Port of West Sacramento and Port of Stockton, respectively. In addition, the barges and the associated tugboats would operate in accordance with requirements of the U.S. Coast Guard and the Division of Boating and Waterways of the California Department of Parks and Recreation. Notifications would be provided to the U.S. Coast Guard and local marinas.	Jim Lorenzen	5/27/2020	Responded
6.80	3/11/20	Barbara Barrigan-Parrilla	Will we have a session where we can review and discuss DWR's HABS data and the SCCWRP HABS Impacts Study that was discussed on the Region 5 Water Board HABS Committee update Monday? What I am looking for is how alignment choice will impact development of HABS and if there is an opportunity to use the project to increase water circulation in hotspots to mitigate HABS early on/and in later years of project operation.	Water quality and HABS will be part of the environmental analysis that DWR will conduct in the EIR.	Carrie Buckman	5/27/2020	Responded

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7.01	4/22/20	Barbara Barrigan-Parrilla	In WaterFix, it was known there was a tremendous amount of diesel emissions for construction for this part of the project. Looking at a concrete batch down there. Conversations have been had with Ms. Mallon about moving everything to electric. Is there a commitment by the exporters to fund and will we really get to 100% because those emissions, for health and safety reasons, would require complete relocation for the town of Byron and it would be really dangerous diesel emissions for the kids that go to school nearby. I am not worried about the operation of managing water and flow creating a flood condition. I am sure that will be worked out. Is this being built to a 200-year standard?	DWR will analyze potential air quality impacts and mitigation as part of the EIR preparation. However, currently available technology includes a range of options to reduce air quality emissions. For example, dust issues at batch plants primarily occur as the dry ingredients are mixed together prior to the addition of water to make the concrete, slurry, or grout. The batch plants would be required to install the equipment that receives and mixes the dry ingredients within a shelter that includes large fans and air filtration equipment to minimize particulate matter (dust) from leaving the construction site. The maximum amount of dust leaving the construction site would be regulated by the Regional Air Quality Management District. In addition, many earthwork types of earthwork equipment are currently being provide as hybrid diesel-electric engines to reduce emissions. Electric engines would be used for generator sets, air compressors, and other equipment to the extent practical.	Gwen Buchholz	5/27/2020	Responded
7.02	4/22/20	David Gloski	A career barge operator on the San Joaquin said it isn't logical to go into the winding waterways of Little Potato Slough depending on the size of barges. Barges should be out on deeper water on the San Joaquin. Perhaps the Tidal Marsh area should be across the southern end of the island so that an avenue for barge landing access could be out on the main river. There has to be a way to move this around to make it work. Could the shaft be moved to the west a bit to make it closer to a barge on that side?	Little Potato Slough is shallower than Potato Slough. The proposed barge landing along Bouldin Island would be located in Potato Slough with nearby access to the San Joaquin River.	Jim Lorenzen	5/27/2020	Responded
7.03	4/22/20	Sean Wirth	It would be much better to locate it in a wider area of the island. Based on this feedback, the shaft was moved further north and placed it right along the road to keep the impact closer to the road. The benefit of this location is that it is located close to a house that has power lines. It would be the least evil place to put it on the island in terms of impacts to cranes.	If this comment is associated with Staten Island maintenance shaft site, the proposed shaft site was moved north of the previously identified site.	Jim Lorenzen	5/27/2020	Responded
7.04	4/22/20	David Gloski	It may be a good idea to add this area [Bouldin Island Barge Landing] to a tour so that there is a clearer understanding of what is out there.	This area would be considered as part of future tours of potential DCA facility locations.	Jim Lorenzen	5/27/2020	Responded
7.05	4/22/20	Anna Swenson	Asked for an explanation for some of the terms used in the map legends, including "Regenerative Ag" on the Bouldin Island slide and the terms used on the intakes slide.	The term "Regenerative Ag" on Bouldin Island was included in a presentation to the Board of Directors of the Metropolitan Water District of Southern California. The term generally means a combination of farming based on a combination of biodiversity, watershed improvements, agroforestry, and enhanced ecosystems that includes capture of carbon in soils and associated biomass (including covering peat soils) to reduce greenhouse gas emissions.	Jim Lorenzen	5/27/2020	Responded
7.06	4/22/20	Karen Mann	The waterway of the proposed barge landing is known as Little Potato Slough and it has been used for anchorage, fishing and other water sports by Delta families for several decades. What happens on the landside of the barge landing?	The proposed barge landing along Bouldin Island would be located in Potato Slough with nearby access to the San Joaquin River. The barge landing would be approximately 1,200 feet long along the bank of the river or slough and would be constructed into the existing levee to minimize extension into the waterway. The barge landing would extend approximately 600 feet to the landside of the existing levee. Trucks would drive on the landside of the levee and move materials from barges to the launch shaft site.	Jim Lorenzen	5/27/2020	Responded

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7.07	4/22/20	Cecille Giacomia	How exactly would barges go around Sherman Island?	Barges from the Port of West Sacramento would enter the Sacramento River and navigate under the Rio Vista Bridge and Three Mile Slough Bridge to the proposed barge landing on Bouldin Island. Barges from the Port of Stockton would navigate the San Joaquin River to Potato Slough without crossing under any bridges.	Jim Lorenzen	5/27/2020	Responded
7.08	4/22/20	Karen Mann	Would a noise factor be involved? Noise is amplified on water. The residents of Korth's Pirate Lair Mobile Home Park would be subject to that noise. There are also homes along the San Joaquin river that will be affected by the noise. The area is referred to as The Bedrooms by recreational boaters and is used as anchorage by boaters who don't want to harm the environment. There is concern also about trucks driving on the levees.	DWR will evaluate the potential effects of barge traffic on noise in the waterways as part of the EIR preparation.	Jim Lorenzen	5/27/2020	Responded
7.09	4/22/20	Karen Mann	Would the barge stay there until another barge comes and picks it up?	The tugboat would remain with the barge until it would be unloaded, and then the tugboat would return the barge to the main port.	Jim Lorenzen	5/27/2020	Responded
7.10	4/22/20	James Cox	Going around Sherman Island would require crossing Sherman Lake, which is very shallow. Dredging would be required if barges went through on a regular basis.	Under the current options, the barge routes would remain in the San Joaquin River/Stockton Deep Water Ship Channel and would not enter Sherman Lake and the Lower Sherman Island Wildlife Area.	Jim Lorenzen	5/27/2020	Responded
7.11	4/22/20	Michael Moran	Going down the Sacramento River through 3-Mile Slough would mean going right by Brannan State Recreation Area which is a choke point for a lot of motorized and non-motorized recreation traffic. There would also be people on the beaches at 7-Mile Slough. Beyond that point is Sherman Lake State Wildlife Area. It seems like the next feasible area would be Broad Slough.	Under the current options, barges would travel Three-Mile Slough only if the goods were being transported from the Port of West Sacramento. All other barges would remain the San Joaquin River/Stockton Deep Water Ship Channel.	Jim Lorenzen	5/27/2020	Responded
7.12	4/22/20	James Cox	There are barges that go through Broad Slough but it is uncertain what their drafts are. There isn't an actual channel there, but it is possible to go through there. However, it adds a lot of distance onto the route.	Under the current options, barges would not enter Broad Slough or the Lower Sherman Island Wildlife Area, and would remain the San Joaquin River/Stockton Deep Water Ship Channel.	Jim Lorenzen	5/27/2020	Responded
7.13	4/22/20	Michael Moran	Keep in mind the drought barrier that is going in at False River and how that changes the flows and tidal actions coming down from 3-Mile Slough pretty dramatically. It's unknown when it will actually go in, but it is something to keep in consideration.	It is recognized that the proposed barge route between the Port of West Sacramento and the proposed barge landings at either Bouldin Island or Lower Roberts Island would include several reaches that could cause delays due to shallow and or narrow waterways and schedules for two operable bridges.	Jim Lorenzen	5/27/2020	Responded
7.14	4/22/20	Karen Mann	There are a couple of areas that Ms. Mann provided to the DCA staff that would be affected by the Central Route, but those don't appear to be reflected on the map. The Mildred Anchorage Area is not noted and neither is Byron Elementary School.	The map discussed at the April 2020 SEC meeting did not include all of the features presented on other DCA maps.	Jim Lorenzen	5/27/2020	Responded
7.15	4/22/20	Cecille Giacomia	The barge depth will need to be compared to the channel depth if you intend to go around Sherman Island.	It is recognized that the proposed barge routes outside of the Stockton Deep Water Ship Channel would include several reaches that could cause delays due to shallow and or narrow waterways where navigation would be required to wait until appropriate tide levels and that smaller barges would be required.	Jim Lorenzen	5/27/2020	Responded

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7.16	4/22/20	Cecille Giacoma	Where does the borrow come from? Referring to the clay to mix with the fines.	Under the current proposal, soils for constructing embankments and other fills would be provided from several locations. On many sites, fine-grained clayey material needed for construction would be excavated at the construction site, including at the intake sites. The RTM would be used to construct the Southern Forebay embankments and the elevated structures at the tunnel shaft sites. Soils purchased from existing commercial businesses also would be used, including clay materials to form the center of the Southern Forebay embankments and structures at the tunnel launch shaft sites prior to generation of RTM.	Graham Bradner	5/27/2020	Responded
7.17	4/22/20	Barbara Barrigan-Parrilla	There is a lot of subsidence on Bouldin Island and a there's a lot of weight in the launch shaft area. There will need to be more details about flooding and how the land will hold up as the project planning progresses.	Ground improvement would occur at areas on Bouldin Island to strengthen the soils beneath the proposed structures and areas to be filled, including the tunnel shaft site, tunnel segment storage areas, and barge landing.	Andrew Finney	5/27/2020	Responded
7.18	4/22/20	Cecille Giacoma	When will the biological surveys be completed for Bouldin Island and where will the burrow fill for the tunnel shaft be acquired?	DWR will evaluate biological characteristics of project sites for the selected alternatives as part of the EIR preparation. The proposed tunnel shaft would be constructed from material transported from the tunnel shaft construction site at Glanville Tract.	Andrew Finney	5/27/2020	Responded
7.19	4/22/20	Cecille Giacoma	Is the team aware that Bouldin Island is -17 feet elevation? The levees on the south side are very fragile.	The subsidence and levee conditions at Bouldin Island have been considered. Ground improvement and levee strengthening on the interior landside of the levees would need to occur prior to construction of a tunnel shaft.	Andrew Finney	5/27/2020	Responded
7.20	4/22/20	Gil Cosio	The DCA might want to check on the volume of material that will be needed to raise the ground to reach the Tidal Marsh elevation. Likely several million yards of material will be needed. If seven million yards is needed for the forebay, there may not be enough material.	The graphic presented at the April 2020 SEC meeting was developed several years ago for another project. As part of the EIR preparation, DWR will identify necessary mitigation and consider methods (and sites) to implement the mitigation needs.	Gwen Buchholz	5/27/2020	Responded
7.21	4/22/20	Anna Swenson	DWR sent out guidelines for their participation with the project and it clearly stated how they intend to participate with the Delta. I do not see how that is possible with the current state. I will email it for the record. There is a specific section talking about how they will engage with the communities and there is no way to legally do what it states. They need to either change their guidelines to say that they will be able to participate with anyone who has computer and internet access.	DWR has acknowledged the need to find creative ways to ensure continued access to public information and participation as it continues important work, and has generated some possible ideas for doing so while also following public health protocols. These ideas are a mix of electronic and non-electronic means, among other strategies. From the blog post: "Public engagement in government-led processes is critical and we need to find ways to enable every member of the community to have access."	Carrie Buckman	5/27/2020	Responded

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7.22	4/22/20	Douglas Hsia	I am also interested in the fish screen because I read that Clifton Forebay has a nonperforming fish screen getting all the smelt. I am more interested in why that cannot be fixed.	<p>The Delta Conveyance Project does not include any improvements to Clifton Court Forebay or the existing fish facilities in the South Delta. The DCP objective is to improve water supply reliability for the State Water Project. The new intake facilities and conveyance system are physically separated from the existing South Delta facilities for this purpose.</p> <p>The existing SWP (and CVP) fish facilities in the South Delta use louvered screening and fish collection systems that behaviorally separate fish from the diverted flow and draw the fish into large collection tanks. These fish are then routinely transported to fish release sites in the western Delta, well away from the South Delta diversion's hydraulic influence. While these systems are not as efficient as new facilities, DWR continues to maintain and improve the fish collection systems so they perform as intended. All fish losses are monitored and mitigated per existing agreements and permitting requirements with the fish agencies. Fish losses due to high predation rates across Clifton Court Forebay, located just upstream of the SWP fish facility, are probably more significant than the facility fish losses. DWR is currently engaged in significant predator removal programs within the CCF to reduce these potential losses. DWR is investigating long term strategies and solutions in the South Delta to reduce these losses, in collaboration with the fish agencies. DWR operates to reduce diversions in the South Delta, when sensitive species are most vulnerable to losses, in accordance with our Incidental Take Permit for Long-Term Operations. DWR is also evaluating long term operational strategies using the DCP diversions to allow flexible water withdraws between North and South Delta facilities to reduce overall fish losses in the Delta.</p> <p>Unlike the South Delta fish facilities, the new fish screens proposed for the DCP will use State-of-the-Art on-river technologies that do not collect or handle fish. The DCP intake facilities will use very fine slotted screens and operate at very low velocities to protect fish. These features allow fish to easily swim away from the intake as they migrate through the area.</p>	Carrie Buckman	5/27/2020	Responded
7.23	4/22/20	James Cox	This should be incorporated into the project, not a separate project. It has been delayed and stalled for years. Fishermen have gotten to the point where we don't believe anything that is said about this because there have been so many promises in the past. He urged to keep in mind that Clifton Court is the biggest fish killing location in the Delta. Once fish get in, they do not get out. It really needs to be addressed. There is a project that demands an improvement of habitat, this would be the biggest habitat that could be improved in the Delta.	See response to above comment.	Carrie Buckman	5/27/2020	Responded

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7.24	4/22/20	Barbara Barrigan-Parrilla	Is that from the fourth climate change analysis? I would strongly urge a comparison be done to the report from the fourth climate change analysis because my concern is not just the combination of sea level rise hurting facility coming up the San Joaquin but storm events coming down the San Joaquin. The two together seem like the perfect storm for catastrophe.	The climate change and sea level rise projections were prepared by DWR based upon the recent published analyses completed by the State of California. The climate change projections for river flows include consideration of changes in hydrologic conditions in the upper watersheds of the Sacramento and San Joaquin rivers. Flood protection of project facilities and operations to address climate change and sea level rise is one of the primary goals of the project team. Climate Change and Sea Level Rise assumptions for design and operations analysis of the Delta Conveyance Project are consistent with the projections that were part of California's 4th Climate Change Assessment. Design of the new facilities will be based extreme sea level rise projection for 2100 along with late century 200-year Climate Change hydrology. DWR is also using the latest available dataset of Global Climate Models (GCMs) to develop future hydrology scenarios. We are using most current science and climate change data for conceptual design with a recognition that Climate Change and Sea Level Rise projections are evolving and further analysis using updated data and tools may be necessary for final design and construction. As part of the water resiliency portfolio approach, State and local efforts will be needed to address levee integrity and general Delta inundation with changing climate and sea level rise.	Gwen Buchholz	5/27/2020	Responded
7.25	4/22/20	Karen Mann	The only way in and out of Discovery Bay is on the river that this goes right under, and that is an issue.	New map books will be provided for the May 2020 SEC meeting.	Gwen Buchholz	5/27/2020	Responded
7.26	4/22/20	Karen Mann	The maintenance shaft looks very close to the water treatment plant and sewage plant that serve the residents of Discovery Bay and Byron. That is the only drinking water for as many as 20,000 people.	The proposed Byron Tract Tunnel Maintenance Shaft is located on property to the east of the Discovery Bay community. The water and wastewater facilities that serve Discovery Bay and that are located to the north of State Route 4 are located within the Discovery Bay community. The tunnel shaft construction would include installation of a slurry wall or diaphragm wall around the shaft to isolate the construction site from adjacent groundwater and surface water.	Gwen Buchholz	5/27/2020	Responded
7.27	4/22/20	David Gloski	Is there any gateway to the Delta on the I-5, like a visitor's center? That is an idea of what could be done there.	The DCA is in the process of collecting suggestions and ideas on community benefits and site reuse as part of the proposed project. When the DCA has compiled this information, we look forward to discussions with the communities about community benefits including the community's vision for a visitor's center, and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in a visitor's center for the Delta.	Nazli Parvizi	5/27/2020	Responded
7.28	4/22/20	Barbara Barrigan-Parrilla	It would be great if there were smaller, satellite centers that could work in conjunction with the centers Mr. Shiedigger is planning. With many entry points to the Delta, there should be many points of access for visiting the Delta. Land cannot be returned to productive agricultural use, and that has to be accounted for in regards to lost revenue and property taxes to the county's tax base. As much of the land as possible should be turned back into habitat that is compatible with the natural Delta. Opportunities for biking and trails with that type of restoration would be a good feature to have at a visitor's center.	The DCA is in the process of collecting suggestions and ideas on community benefits and site reuse as part of the project. When the DCA has compiled this information, we look forward to discussions with the communities about community benefits including the community's vision for a visitor's center and recreational opportunities, and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in a visitor's center for the Delta.	Nazli Parvizi	5/27/2020	Responded

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7.29	4/22/20	Douglas Hsia	The entry point for the Delta should be Freeport at the Cosumnes.	The DCA is in the process of collecting suggestions and ideas on community benefits as part of the project. When the DCA has compiled this information, we look forward to discussions with the communities about community benefits including the community's vision for a visitor's center and recreational opportunities at several locations throughout the Delta, and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in a visitor's center for the Delta.	Nazli Parvizi	5/27/2020	Responded
7.30	4/22/20	Anna Swenson	There should be collaboration with the Delta Protection Commission to ensure any visitor center plan isn't a duplicated effort.	The DCA and DWR have been meeting with the Delta Protection Commission, and will continue to meet with this agency as the project progresses.	Nazli Parvizi	5/27/2020	Responded
7.31	4/22/20	Karen Mann	Ken Shiedigger is trying to put a visitor center together at the corner of Hwy. 160 and Hwy. 12. Will the affected property owners get an easement or reimbursement for the land taken for construction and operations?	As a general rule, any land and/or easements utilized for the Delta Conveyance Project would be acquired by DWR (potentially with the DCA acting as DWR's agent).	Gwen Buchholz	5/27/2020	Responded
7.32	4/22/20	Peter Robertson	It is necessary to change how outreach is conducted because it is not possible right now to address large groups. If DCA can provide speakers to small meetings, how quickly can a speaker task force be assembled? What will their availability be? Can they have materials available in both electronic and printed format? A lot of the facilities used up until six weeks ago have now been locked down. It is difficult to find a space where you can have even a small group of people. Even when restrictions are lifted, people will be gun shy about getting together.	The DCA team would be happy to work with any interested stakeholder groups who would like presentations of our materials. The DCA will make staff available at mutually suitable times and will follow the latest health and safety guidelines put forth by the state to keep themselves and members of the public safe. In the near future, the DCA can help organize online presentations as needed and move towards in person meetings if/when those are allowed and desired. Materials are always available on our website, printed materials distribution is not guaranteed at this time.	Nazli Parvizi	5/27/2020	Responded
7.33	4/22/20	Cecille Giacoma	It is questionable that the Governor wants DCA to move forward at this time, and a direct order from him is requested.	Please refer to <a href="https://covid19.ca.gov/img/Executive-Order-N-33-20.pdf">https://covid19.ca.gov/img/Executive-Order-N-33-20.pdf</a> for more information on EXECUTIVE ORDER N-33-20 on the Governor's State of Emergency declaration and Memorandum on Identification of Essential Critical Infrastructure. Please note that Director Nemeth, as the Governor's representative, has directed DWR to continue its work on the Delta Conveyance Project.	Nazli Parvizi	5/27/2020	Responded

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7.34	4/22/20	Barbara Barrigan-Parrilla	While DCA is incorporating feedback and once restrictions start to ease, SEC members could participate in self-guided (rather than bus) tours. Walkie-talkies could be used to communicate while maintaining proper social distancing. The visual visits are critically important to think things through, understand the conditions on the ground and go back to groups SEC members work with to envision the best option. Ms. Mallon said at the DCA Board meeting that comments could be taken any time later. Rather than conducting another meeting in one month, consider holding it in maybe six or eight weeks. After SEC members can participate in tours, DCA should provide them 6-7 weeks to safely conduct small group outreach in light of limited capacities and social distancing orders. SEC members will need to be creative in how to get information to the DCA, which can be done, but additional time will be needed.	The DCA is currently exploring how to best organize tours of proposed facility sitings in a manner that is safe for all. The DCA will present options to the SEC at the May 2020 meeting.	Nazli Parvizi	5/27/2020	Responded
7.35	4/22/20	Dr. Mel Lytle	Has the DCA been able to determine flood control risk for the proposed site along Twin Cities Rd. and to the west of I-5? In the flood of 1986, the I-5 flooded at that location.	Due to historic floods within and near Glanville Tract, a ring levee would be constructed around the proposed Twin Cities Consolidation Center and other parts of the tunnel launch shaft site during construction. The ring levee would be removed following removal of the construction equipment.	Graham Bradner	5/27/2020	Responded
7.36	4/22/20	Douglas Hsia	Only intakes 2, 3 and 5 are shown. What happened to intakes 1 and 4?	Intakes 1 and 4 are not being studied by DCA as they are not in the Notice of Preparation as potential intake sites. The DCA may study these or other intake sites as directed by DWR through the environmental process.	Phil Ryan	5/27/2020	Responded
7.38	4/22/20	Michael Moran	How much peat is going to be moved out? How much is going to be put in storage? Why is it being covered up and not being used elsewhere for restoration projects?	It is estimated that approximately 700,000 cubic yards of peat would be removed at the Southern Forebay configuration under the locations of the embankments, tunnel shafts, and spillway foundations. The DCA is not aware of beneficial reuse opportunities for peat. Therefore, the current plan would be to place the peat within excavations and cover the area with RTM or topsoil to limit long-term oxidation and greenhouse gas emissions.	Graham Bradner	5/27/2020	Responded
7.39	4/22/20	Sean Wirth	The situation is that either the local residents are affected, or the wildlife species are affected. Anything to reduce the length of the roads would help, and splitting it would be better than nothing.	Potential modification of traffic corridors will be discussed at the May 2020 SEC meeting to obtain further information.	Jim Lorenzen	5/27/2020	Responded
7.40	4/22/20	Sean Wirth	I spoke to the Friends of Stone Lakes and the Stone Lakes managers. The north/south road are very environmentally damaging for the refuge. There are birds foraging on both sides of the entire length of that haul road. These roads would dramatically affect the ecosystem services of that preserve for listed species. The Hood-Franklin Road usage is not great but there is already an existing road. Having a dirt tract with lots of use inside the preserve is very damaging. It is already a very constrained refuge with other existing issues, and it would not be good to impact it any further.	Potential modification of traffic corridors will be discussed at the May 2020 SEC meeting to obtain further information.	Jim Lorenzen	5/27/2020	Responded

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7.41	4/22/20	David Gloski	Where is the RTM going generated by the Bouldin Island Launch Shaft?	The DCA team is still working on the RTM balance to provide adequate soils to tunnel shaft sites, Southern Forebay, and potential mitigation sites to be considered by DWR. The RTM also could be considered for reuse by other entities in the Delta which have not been identified at this time.	Steve Dubnewych	5/27/2020	Responded
7.42	4/22/20	Anna Swenson	How many Reclamation Districts have signed up to take the RTM?	The DCA team is still working on the RTM balance to determine the volume of RTM that would be available for non-project uses. At this point in time, the DCA team has not contacted reclamation districts to determine the future demand for RTM.	Steve Dubnewych	5/27/2020	Responded
7.43	4/22/20	Anna Swenson	Perhaps the RTM could be provided to RD's for free.	As currently planned, the surplus soil material could be made available to reclamation districts without charge. However, loading, transporting, logistics, and determination of the suitability of the soil material for the reclamation districts' purposes would be the responsibility of the reclamation districts.	Steve Dubnewych	5/27/2020	Responded
7.44	4/22/20	Cecille Giacoma	The ITR stated the RTM was not reusable?	The analysis of the RTM characteristics was not available to the Independent Technical Review (ITR) that reviewed the Tunnel options. The ITR based their comments on their past experiences on other projects that were not located in the Delta. There will be additional work conducted to demonstrate that the RTM can be reused. DCA engineers are confident that the material is appropriate to use for embankments with proper drying of the material and construction with a clay core in the embankment in the same manner as other levees throughout the Delta.	Steve Dubnewych	5/27/2020	Responded
7.45	4/22/20	James Wallace	The DCA has a high-level of confidence that the RTM will meet specifications for constructing all the embankments, but he is confused because the material is homogenized as it comes out as RTM. Will the material be sorted? Or do you just anticipate the homogenized material will meet spec? I assume this has to be an engineered fill. It says "fine-grain" which has a pretty geotechnical definition. How will the RTM be managed? A lot of it is being used to build some important structures.	The RTM material would be homogenized at the tunnel launch sites and at the construction sites. The embankment material would need to include at least 20 to 30 percent fine material. Based upon current geotechnical information, it appears that the tunnel would be bored in areas that would generate material that would produce appropriate soils. RTM materials that would not meet the embankment design criteria would be placed in a separate location at the RTM storage area.	Steve Dubnewych	5/27/2020	Responded
7.46	4/22/20	Karen Mann	A major concern regarding emergency medical assistance is that eastern Contra Costa County was reduced from nine fire stations down to one. It is located on Bixler Road. There is no longer a fire station on Bethel Island or in Byron, which is where this is pretty much at. As it is, there is only one engine unit to support all the homes that have been built out on Discovery Bay and Byron area.	The DCA is aware of the limitations of existing first responder agencies throughout the Delta. Emergency response facilities and crews would be required to be provided by the Delta Conveyance Project in accordance with the requirements of California Division of Occupational Safety and Health (Cal/OSHA) at the tunnel launch shaft sites and near the intake sites. DCA would like to work with the communities to identify methods to help supplement community emergency services.	Phil Ryan	5/27/2020	Responded
7.47	4/22/20	Karen Mann	If the water goes over the freeboard and into the river, would the water level then increase and be dispersed to the north and the south?	As proposed, the Southern Forebay would include an Emergency Spillway in accordance with the Division of Safety of Dams requirements in case the water levels rise above the freeboard elevation (probably due to extensive rainfall at the Southern Forebay). The water would flow through the bypass into Italian Slough where the water would flow into Old River and the Delta.	Phil Ryan	5/27/2020	Responded

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7.48	4/22/20	Karen Mann	Would this occasion hypothetically would happen more towards the wintertime, summertime, or spring? The reason is because many, maybe 4,000 homes are actually waterfront sites and when the dams were released about 10 years ago, they all experienced incredible flooding in their homes. So, is this something they will need to be aware of for their own personal homes and businesses?	Most reservoirs regulated by Division of Safety of Dams are located in natural watersheds with rivers flowing directly into the reservoirs. Therefore, the reservoirs would be designed to contain precipitation, snowmelt, and stored water under design peak flood conditions. At the Southern Forebay, the proposed reservoir is a fully contained system and only receives water from the intakes through the pumping plant or direct rainfall on the water surface. If surface water elevations encroached into the freeboard, gates at the intakes could be closed to reduce inflow into the forebay. The emergency spillway also would be designed for operations in the unlikely occurrence of a malfunction of controls such as failure of fail safe devices, power outages, and/or gate malfunctions. Although these conditions are highly unlikely to occur, the emergency spillway must be designed to consider these potentially rare events.	Phil Ryan	5/27/2020	Responded
7.49	4/22/20	Karen Mann	The odds of this flooding our properties are becoming more likely.	The Southern Forebay emergency spillway would be designed for flows that would occur when the forebay would be full with excessive rainfall on the forebay water surface with the unlikely occurrence of a malfunction of controls such as failure of fail safe devices, power outages, and/or gate malfunctions that would not reduce flows from the intakes. Although these conditions are highly unlikely to occur, the emergency spillway must be designed to consider these potentially rare events which could release up to 6,000 cubic feet/second into Italian Slough with flows into Old River and other south Delta channels. However, without the emergency spillway to control releases of overflows under this highly unlikely event. The overtopping and loss of the embankment cause flooding of Byron Tract and surrounding areas.	Phil Ryan	5/27/2020	Responded
7.50	4/22/20	Anna Swenson	What will be the ongoing noise from the operation on the surrounding communities? I would like to see a map in detail of what the houses would look like and where they are in relation to this.	Regarding work in the Southern Complex Area discussed at the April 22 SEC Meeting: Noise should be minimal from the facilities to the nearby homes at most construction sites. DWR will analyze potential for noise effects at sensitive receptors during construction and operations as part of preparation of the EIR.	Phil Ryan	5/27/2020	Responded
7.51	4/22/20	Anna Swenson	Why would the tunnel ever need to be dewatered? What scenario would make that relevant?	The tunnel would need to be dewatered for inspection on a periodic basis. The inspection interval has not been determined. However, inspection once every 10 years could occur. To dewater the tunnel, water would be pumped at the Pumping Plant and discharged into the forebay in a manner similar to normal operations.	Phil Ryan	5/27/2020	Responded
7.52	4/22/20	Cecille Giacomini	Are the trucks hauling borrow fill are included in the truck traffic graphic?	Most of the RTM and soil material would be moved to the Southern Forebay by rail. Trucks would be used to move this material between tunnel shaft locations and other construction sites. The projected truck trips are being developed and will be discussed further at the May 2020 SEC meeting.	Jim Lorenzen	5/27/2020	Responded
7.53	4/22/20	David Gloski	I'm glad to see Italian Slough will be utilized. Would like to promote this as a dual benefit facility. With the issues going on with algae and health with the water down in the South Delta, there is a benefit to be able to take some of this water and flush it back into the Delta during times when there are problems. Have you thought about other plumbing? There might be other options than over a spillway. Could there be a flow control device needed on one of the forebays into Italian Slough? Asked Carrie if there are plans to look at this as part of the CEQA process.	The Emergency Spillway into Italian Slough would only be used for an extremely rare emergency situation. Currently, there are no plans to discharge flows from the Southern Forebay into Italian Slough or other surface waters. DWR will be analyzing the effects to water quality (including algae) as part of the preparation of the EIR. At that time, they will assess the potential mitigation measures, including an option to use water from the forebay to improve quality in the south Delta.	Carrie Buckman	5/27/2020	Responded

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7.54	4/22/20	Barbara Barrigan-Parrilla	In WaterFix, it was estimated that the existing pumps would be used without tunnel operation 52% of the time. Isn't this the time to go back to Cal Fed and fix the fish screens for when the existing pumps are used? It seems like it should be engineered in because there is so much opportunity there to improve that set of conditions at the same time for fisheries. Does that mean it would be incorporated into construction at this time or would it be run separately?	<p>The Delta Conveyance Project does not include any improvements to Clifton Court Forebay or the existing fish facilities in the South Delta. The DCP objective is to improve water supply reliability for the State Water Project. The new intake facilities and conveyance system are physically separated from the existing South Delta facilities for this purpose.</p> <p>The existing SWP (and CVP) fish facilities in the South Delta use louvered screening and fish collection systems that behaviorally separate fish from the diverted flow and draw the fish into large collection tanks. These fish are then routinely transported to fish release sites in the western Delta, well away from the South Delta diversion's hydraulic influence. While these systems are not as efficient as new facilities, DWR continues to maintain and improve the fish collection systems so they perform as intended. All fish losses are monitored and mitigated per existing agreements and permitting requirements with the fish agencies. Fish losses due to high predation rates across Clifton Court Forebay, located just upstream of the SWP fish facility, are probably more significant than the facility fish losses. DWR is currently engaged in significant predator removal programs within the CCF to reduce these potential losses. DWR is investigating long term strategies and solutions in the South Delta to reduce these losses, in collaboration with the fish agencies. DWR operates to reduce diversions in the South Delta, when sensitive species are most vulnerable to losses, in accordance with our Incidental Take Permit for Long-Term Operations. DWR is also evaluating long term operational strategies using the DCP diversions to allow flexible water withdraws between North and South Delta facilities to reduce overall fish losses in the Delta.</p> <p>Unlike the South Delta fish facilities, the new fish screens proposed for the DCP will use State-of-the-Art on-river technologies that do not collect or handle fish. The DCP intake facilities will use very fine slotted screens and operate at very low velocities to protect fish. These features allow fish to easily swim away from the intake as they migrate through the area.</p>	Carrie Buckman	5/27/2020	Responded
7.55	4/23/20	Barbara Barrigan-Parrilla	Air quality: We need to see some strong documentation that shows that we are moving to electric construction equipment etc. to eliminate the diesel emissions. And will air quality impacts require green planting around the community of Byron for air filtration? Indoor air monitors and extra air filtration equipment for area schools?	The DCA has identified the current availability of electric equipment, hybrid diesel construction equipment and transit trucks, compressed natural gas trucks and other equipment, Tier 4 construction equipment and transit trucks, Tier 4 locomotives, and hybrid and electric vehicles to move employees and materials between sites. It is anticipated that over the next 15 years as the project is designed and constructed, the availability of electric and hybrid equipment and vehicles will increase including for tugboats. The EIR will analyze potential changes in air quality and identify potential mitigation measures to reduce significant adverse impacts.	Gwen Buchholz	5/27/2020	Responded

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7.56	4/23/20	Barbara Barrigan-Parrilla	I am guessing that the truck trips, railroad deliveries etc to this significant construction zone are coming from the Port of Stockton. I believe the area from the Port of Stockton to Clifton Court needs to be treated as an air pollution corridor during construction. Air filtration, green plantings around schools and houses, indoor air monitors, noise barriers for schools need to be targeted around Boggs Trac, Conway Homes, Weston Ranch, and other areas in South Stockton adjacent to this traffic corridor. South Stockton is one of the most tree barren areas in the State, temperatures from climate change in the summer are already 10 degrees higher than in North Stockton, death rates fall 18 years younger in age, and this area experiences the 4th highest rate of asthma in the country. Truck traffic, needed Port expansion, concrete batching, train and barge traffic, will make these conditions all worse. Can mitigation include a major tree planting effort within these communities and funding for local NGOs to hire local workers to do the planting and tree maintenance? We need to transform these communities into green corridors during construction to offset impacts. The goal should be to leave the community better than you found it.	As part of the EIR preparation, DWR will analyze potential changes in air quality due to implementation of the alternatives and identify potential mitigation measures to reduce significant adverse impacts, including public health impacts. The air quality analysis will be conducted for each construction site and within each air basin. Potential air quality considerations will be discussed at future SEC meetings.	Gwen Buchholz	5/27/2020	Responded
7.57	4/23/20	Barbara Barrigan-Parrilla	We have difficulties in the Iron Triangle, center of railroad traffic in South Stockton presently. It is an overly crowded train traffic area, and we have problems with trains idling engines for long periods of time. We need the power of the State of California and the DCA to improve this situation with construction so that idling/air pollution is reduced at that site as well.	As part of the EIR preparation, DWR will analyze potential changes in air quality due to implementation of the alternatives and identify potential mitigation measures to reduce significant adverse impacts, including public health impacts. The air quality analysis will be conducted for each construction site and within each air basin. Potential air quality considerations will be discussed at future SEC meetings.	Gwen Buchholz	5/27/2020	Responded
7.58	4/23/20	Barbara Barrigan-Parrilla	For the Port of Stockton, if the DCA is going to use electric barges etc., we need to work together to push the Port to being a clean Port. We need the jobs in SJ County, and many fine people are part of Port leadership. They are community oriented, but they do things oddly, like not publish or notify the public about EIRs for Port expansion. If this project comes to pass, community benefits to offset construction impacts should focus on modernizing the Port of Stockton and making it a model, clean Port. I will again address Port concerns with this project when I discuss water quality and HABs in a later point.	As part of the EIR preparation, DWR will analyze potential changes in air quality due to implementation of the alternatives and identify potential mitigation measures to reduce significant adverse impacts, including public health impacts. The air quality analysis will be conducted for each construction site and within each air basin. Potential air quality considerations will be discussed at future SEC meetings.	Gwen Buchholz	5/27/2020	Responded

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7.59	4/23/20	Barbara Barrigan-Parrilla	There are studies of the impact of blowing peat soils on communities of color and lung disease in South Stockton from the mid-20th century. Blowing peat causes lung disease and soils with Chromium 6 are a double threat. I know in a prior meeting Kathryn, you said, that we should assume that you will follow best practices. What would be helpful would be a good description of what containment looks like. Explain it to us -- the plans for that -- so that we can train groups to be active citizen monitors. The project could very well outlive some of us. Let's make sure that Delta residents can watch and know that things are being done right, and can report properly and factually if things go wrong. The more the public knows the better. This has been a big lesson of COVID19. More information alleviates fear because the public can monitor what is happening in a factual way.	Excavated peat soils would be placed in previously excavated holes on the construction site and covered with non-peat soil material present on the construction site, including RTM or topsoil. This method would reduce greenhouse gas emissions from the peat soils and minimize the peat dust from leaving the construction site.	Gwen Buchholz	5/27/2020	Responded
7.60	4/23/20	Barbara Barrigan-Parrilla	Neighbors -- There are some longtime farming families living on each side of the proposed South Delta pumping operations. I cannot imagine how any of them could handle living and farming anywhere around that construction zone, even if they are on the opposite side of the proposed construction sites. Please work with care with them. Do right by them. All the air quality comments above apply to them, as they are mostly elderly people, and need protection as well. Also will their water wells for home and farming operations be dewatered? How will you take care of their water needs?	Use of construction methods to reduce dust from leaving the construction site would be implemented at all construction areas. Slurry walls or diaphragm walls would be constructed at the intake, tunnel shaft, pumping plant, and forebay construction sites prior to major excavations to isolate the construction site from the adjacent surface water and groundwater. These methods would protect wells used by homes and farming operations during dewatering activities. Groundwater and surface water monitoring also would occur.	Gwen Buchholz	5/27/2020	Responded

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7.61	4/23/20	Barbara Barrigan-Parrilla	<p>The existing South Delta pumping area was built on top of a Yokuts village. Testimony by tribal experts as part of the CWIN case at the SWRCB for WaterFix covered how they return to this area for native plants that are part of cultural practices to this day. I have heard criticism from some of our tribal reps at recent meetings about the consultation process with DWR. While RTD cannot speak for tribes, we have great empathy for their historical losses in California and advocate for protection of their cultural practices and protection of the natural world on their behalf. If this project advances, please do not just disregard these concerns. Are there ways for these native plants to be moved, replanted and protected? Is there a way to honor their history and culture near new facilities? I don't think such offers make up for the losses endured -- in a way my white person suggestion feels like offering a Disneyland version, or whitewashing, of nature in place of real nature. However, somehow, something needs to happen to recognize the true history, the loss, and reconciliation/inclusion of California tribes if this project moves forward so they can gain strength spiritually, culturally, and economically in California. What would water reparations look like for the water rights to the Delta that they were stripped of by the genocide? This is between you and the tribes, but how this is handled can either show real generosity of spirit from the water contractors and the State of California, or not. Again, we believe that the most impacted parties must somehow see benefits. We see tribes as the most impacted parties historically.</p>	<p>DWR is engaging with tribes through consultation under AB 52 and DWR's Tribal Engagement Policy. To initiate this process, DWR reached out through letters and emails to 121 tribes throughout the study area. DWR has reached out to all tribes that responded. Due to the COVID-19 public health situation, some tribes want to delay discussions regarding this project. DWR has met virtually with interested tribes, and communicated with remaining tribes that they will be available to meet when the tribe is ready. DWR will work with these tribes to identify potential effects to tribal cultural resources and consider potential mitigation measures.</p>	Carrie Buckman	5/27/2020	Responded

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7.62	4/23/20	Barbara Barrigan-Parrilla	How much total electricity will be used for operations at the new South Delta Pumping Facilities? Current pumping requires roughly 15% of the state's electricity (somewhere around there, I would have to dig for the exact number). Are we looking at solar operations to reduce energy use? One of our critiques of WaterFix and other state plans is that energy/greenhouse mitigation is too often based on buying credits elsewhere in the world. This means we live with construction, water, and air pollution impacts without receiving the benefits of mitigation. If electricity consumption is going to remain the same or increase from new pumping operations, can mitigation in energy consumption be directed toward the Delta environmental justice communities? For instance, how many low income Stockton, Iselton, Antioch, North Delta residents can be provided with solar panels/systems to mitigate a set percentage of decrease in energy consumption? Or can struggling cities and towns, and school districts be the beneficiary of provided solar systems as well to offset increases or lack of reduction in energy use. We would really like to see a switch where community benefits mitigate pollution and climate change impacts related to creation of the project within the Delta first. The project is Delta-centric; make the offsets into community benefits; and make them Delta-centric. The people who live with the impacts should receive the lion's share of benefits.		Carrie Buckman		For Future Discussion

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7.63	4/23/20	Barbara Barrigan-Parrilla	Carrie, you said that you would apply the 4th Climate Change analysis to flood protection analysis of the new South Delta facilities. Our concern is not just sea level rise, but storm surge, along with SJ River inundation. This is one of our primary concerns regarding Delta management with or without the tunnel. French Camp slough and the SJ River is the site of the greatest potential for overtopping, and area adjacent to the large Conway Homes public housing community, but everything downstream from that point is at risk, including new Delta pumping facilities. I am glad to hear that you are using sea level rise data for the year 2100. Phil had told me 200-year Army Corps standards at a prior meeting without mentioning this additional standard. Comparing it to DWR's own analysis is essential. Share the answer with us. And please, please, please update design to match flood analysis with climate change modeling up until the time construction begins. You need to be constant consumers of climate change literature and adjust levee protection accordingly. You cannot rely on data from 2010. It seems to me to be a very expensive project for roughly a 50 year life-span. While we may not support the project as the best solution for water management with climate change, we also don't want it to fail if it goes forward. Failure with climate change is not an option. Failure will result in deaths and catastrophic economic loss in our region and for water supply for others. Our sincere critique here is for you all to be nimble and to get it right.	DWR is using the future projections of San Joaquin River inflow (and 10.2 feet of sea level rise) as part of the modeling effort to identify flood levels that must be considered within the new facilities design. Please see earlier comment response regarding the 4th Climate Change Analysis.	Carrie Buckman	5/27/2020	Responded
7.64	4/23/20	Barbara Barrigan-Parrilla	HABs -- I am writing these comments while watching the CA Water Boards' Region V workshop on HABs. Restore the Delta is pursuing funding to become a HABs testing and tracking site with an emphasis on citizen science conducted by area youth. Our goal is to provide lots of data so that we and the Water Boards can understand how HABs are proliferating and work toward elimination of causes. I am particularly concerned about how South Delta Facility construction could increase HABs proliferation? We have seen increased HABs incidents related to barrier installation during the drought around Bradford Island. What are plans for HABs mitigation during South Delta Facility construction? Are floating wetlands a possibility to absorb nutrient loads released during dredging and construction in surrounding rivers and sloughs?	DWR will analyze changes in water quality due to implementation of the alternatives in the EIR, including construction-related water quality concerns.	Gwen Buchholz	5/27/2020	Responded

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7.65	4/23/20	Barbara Barrigan-Parrilla	Opportunities for restoring Mormon Slough with flows off of the Stockton East diverting canal -- similar to the Truckee Creek in Reno. Such flows could help to recirculate water into the Stockton waterfront and reduce HABs. The restoration of Mormon Slough would be a new source of water and riparian restoration. It could also work as an urban renewal program for South Stockton, providing new recreation opportunities, tree planting, and urban walkways. (A San Antonio/Reno river walkway with pocket parks to honor the cultural history of the Delta).	DWR will be analyzing the effects to water quality (including HABs) as part of the preparation of the EIR. At that time, they will assess the potential mitigation measures, including opportunities at Mormon Slough.	Carrie Buckman	5/27/2020	Responded
7.66	4/23/20	Barbara Barrigan-Parrilla	Increased aeration systems installed by the Port of Stockton, State, and local government entities around the Stockton waterfront and near marinas across the South Delta. We also believe that we need in addition to a pipe for the Stockton drinking water plant, some small pipes of water to get freshwater into the Stockton waterfront to prevent HABs.	DWR will be analyzing the effects to water quality and water supply as part of the preparation of the EIR. At that time, they will assess the potential mitigation measures.	Gwen Buchholz	5/27/2020	Responded
7.67	4/23/20	Barbara Barrigan-Parrilla	An aggressive state effort to reduce nitrate loads by the Port, upstream dischargers, and local industry so as to reduce HABs proliferation.	DWR will be analyzing the effects to water quality as part of the preparation of the EIR. At that time, they will assess the potential mitigation measures.	Gwen Buchholz	5/27/2020	Responded

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7.68	4/23/20	Barbara Barrigan-Parrilla	<p>Fish screens. I asked my question about the installation of new fish screens for exiting pumps that will be used maybe half the time with the new tunnel facility. Carrie, DWR maintains it is a separate project. This is not right. If we are rebuilding the South Delta facility, let's fix all of its elements. Not doing so would be akin to remodeling a new home and failing to replace the failing electrical system because it is a "separate" project. Frankly, we have given up on the idea at RTD that beneficiaries will ever pay for screen replacement on existing pumps. We would support state financing of such a repair and would work to bring the public along to supporting that idea. In a post-Covid world, it would be a waste of a good opportunity to do the job the right way and reduce the kill of endangered fish.</p>	<p>The Delta Conveyance Project does not include any improvements to Clifton Court Forebay or the existing fish facilities in the South Delta. The DCP objective is to improve water supply reliability for the State Water Project. The new intake facilities and conveyance system are physically separated from the existing South Delta facilities for this purpose.</p> <p>The existing SWP (and CVP) fish facilities in the South Delta use louvered screening and fish collection systems that behaviorally separate fish from the diverted flow and draw the fish into large collection tanks. These fish are then routinely transported to fish release sites in the western Delta, well away from the South Delta diversion's hydraulic influence. While these systems are not as efficient as new facilities, DWR continues to maintain and improve the fish collection systems so they perform as intended. All fish losses are monitored and mitigated per existing agreements and permitting requirements with the fish agencies. Fish losses due to high predation rates across Clifton Court Forebay, located just upstream of the SWP fish facility, are probably more significant than the facility fish losses. DWR is currently engaged in significant predator removal programs within the CCF to reduce these potential losses. DWR is investigating long term strategies and solutions in the South Delta to reduce these losses, in collaboration with the fish agencies. DWR operates to reduce diversions in the South Delta, when sensitive species are most vulnerable to losses, in accordance with our Incidental Take Permit for Long-Term Operations. DWR is also evaluating long term operational strategies using the DCP diversions to allow flexible water withdraws between North and South Delta facilities to reduce overall fish losses in the Delta.</p> <p>Unlike the South Delta fish facilities, the new fish screens proposed for the DCP will use State-of-the-Art on-river technologies that do not collect or handle fish. The DCP intake facilities will use very fine slotted screens and operate at very low velocities to protect fish. These features allow fish to easily swim away from the intake as they migrate through the area.</p>	Carrie Buckman	5/27/2020	Responded

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7.69	4/23/20	Barbara Barrigan-Parrilla	<p>Restore the Delta seeks to create a citizen science program that will move youth from some of our more challenged communities into becoming water scientists, engineers, historians, advocates etc via HABs monitoring and testing. Other groups we work with are developing citizen science and employment opportunities around climate change mitigation and air quality monitoring and mitigation. We want to see workforce development for all the tunnel activity between the Port of Stockton and Clifton Court Forebay to include green jobs for environmental justice communities for mitigation, not just construction. While temporary construction jobs are helpful, they are temporary and do not negate poor environmental outcomes that exist presently on the ground. We would like to see such a strategy around all points of construction for the tunnel -- pulling residents from Isleton, Walnut Grove and Antioch to share in job development opportunities near their communities. Again, to fully offset construction impacts from 23 years of tunnel construction, the goal should be to leave challenged communities better off than you found them. That would build equity into the State Water Project.</p>	<p>The DCA is interested in methods to include local residents in the project implementation. Additionally, DWR is working on outreach related to ideas about Environmental Justice concepts to incorporate in the EIR, and these ideas will be helpful for that effort.</p>	Carrie Buckman	5/27/2020	Responded

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7.70	4/23/20	Barbara Barrigan-Parrilla	<p>Yesterday, we asked several times what was the deadline we had to meet, and a process outline had been provided at one of the recent DCA meetings also covering a timing outline.</p> <p>Kern County Water Agency, however, is using a different outline which I have attached. Kern also reported that, "The DCA delivered its "footprint" for engineering to DWR on April 1, 2020. The "footprint" for engineering serves as the starting point for the environmental analysis necessary for the EIR."</p> <p>So what does it mean that we are still offering input. What is the footprint if it is predetermined? Isn't that what we are working on? What does our work on siting really mean? And how does the SEC fold into this timeline?</p> <p>While I would prefer an answer relatively soon, can you also please explain this at next month's meeting? Committee members should be aware of where the process is really at.</p>	<p>Thank you for your follow-up on the schedule. I was hoping we would get to talk about it on Wednesday, but we didn't have a chance to focus on this topic. I've tried to provide more detailed information about the schedule here.</p> <p>As we've discussed during SEC meetings, DWR was directed by the Governor to start the planning and environmental review process for a proposal for a single tunnel Delta conveyance project with an overall schedule goal of completing the environmental review within 2-3 years. DCA is working under DWR's direction pursuant to the Joint Exercise of Powers Act Agreement (JEPA). Based on this direction, the DCA is developing "Engineering Project Reports" that document the preliminary design work on the alternatives to support DWR's environmental review. In parallel to the development of this information, the DCA organized the SEC to get input regarding specific design and construction activities from Delta stakeholders. During January's SEC meeting, Kathryn Mallon indicated that drafts of the Engineering Project Reports would be delivered to DWR in July. As a part of this, the DCA and DWR planned a two-month period for review and revision of the drafts of the reports, with the final reports originally expected in September. Based on the delay in scoping, we will be delayed in providing the DCA with additional alternatives to work on. I am hoping that we will still be able to have the final product in September, but the draft deadline in July will likely slip.</p> <p>Consistent with the schedule outlined at the November SEC meeting, in early April, the DCA gave DWR initial engineering information on the proposed project to help begin its review. This information is consistent with the material that the DCA has been sharing with the SEC. At the same time the SEC is reviewing this information, DWR's engineering and environmental teams are reviewing this preliminary work to provide feedback for the refinement of the design and construction elements of the alternatives. On the environmental side, sharing this material has been very helpful so that authors can use this information (along with scoping comments) to work on analytical methods and understand and start detailing information for the affected environment sections of the environmental impact report. DWR understands that the DCA's engineering work remains on-going and this draft preliminary information will continue to be developed and refined by the DCA (to a large extent based on SEC feedback). The DCA will be working through the summer, and the SEC can expect to provide feedback on this work during this period.</p>	Carrie Buckman	5/27/2020	Responded

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7.71	5/8/20	Jim Cox	<p>To the fisherman of the delta this is the critical part of this act. Yet we have heard nothing about habitat improvement. When we were told this is a separate project, I ask by whom. Is this a DWR project? Or is this being done by some one else, and if so who?</p> <p>Considering that one of the reasons the twin tunnel project was denied was the lack of habitat restoration in the plan. Is that going to happen again? Seems like an entire re-engineering of Clifton Ct to make it far more fish friendly would go a long ways to satisfying the habitat requirements of the Delta Improvement Act.</p>	DWR's project objectives for the Delta Conveyance Project include adding operational flexibility to the State Water Project to improve operations for aquatic species, but unlike past efforts (like the Bay-Delta Conservation Plan), they do not include a specific objective to restore habitat. DWR has many other efforts (such as EcoRestore) that are focused on habitat restoration. In addition, as a part of the DCP impact assessment, DWR expects that habitat restoration will likely be proposed to mitigate potential impacts to certain biological resources.	Carrie Buckman	5/27/2020	Responded
7.72	2/13/20	James Sarmiento	Requesting GIS Shapefiles for the Drive Shaft Siting Study.	The drive shaft siting studies are still being finalized. The final GIS files can be provided.	Graham Bradner	5/27/2020	Responded
7.73	5/12/20	Douglas Hsia	<p>Re Glanville Tract Launch Shaft:</p> <p>I would like to share with you one of my constituent coming up with the idea of using Dierssen Rd as the haul road plus added facilities to minimize disruption to the existing road. The difference between his and DCA's plan is the freeway interchange. Having the interchange connected from Dierssen Rd would cause less disruption to the Twin Cities Road. The constituent's family has a long farming history in the Delta.</p>	The potential for haul roads with and without new interchanges is being considered for Hood-Franklin Road, Dierssen Road, Lambert Road, and Twin Cities Road. The selection of haul roads will be discussed in more detail at the May 2020 SEC.	Jim Lorenzen	5/27/2020	Responded

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S1.01	2/26/20	Jim Wallace	<p>Intake 2 should be eliminated due to logistics; Intake 5 could affect/take Hemley properties.</p> <p>Can't offer a preference since all would impact friends and neighbors.</p> <p>The intakes are more than a left river bank intrusion. They encroach into the river and effect flood flows which would likely require west bank improvements - maybe even moving the levee right bank levee westward means moving River Road in Yolo County. Levee improvements will be required up and down stream of each intake - which probably means some significant barge traffic. Intake 5, at the north end of Randall Island, may encroach into the abandoned river channel along Highway 160 which created Randall Island- not sure if this is a geotechnical issue, but it might be. Because the intakes would be located within the National Heritage Area and if there are lights located on or around the intakes, I recommend that all project lighting conform to the 2018 International Dark Sky Park Program Guidelines; this should be incorporated into all design elements and specifications.</p>	<p>Artificial outdoor lighting at all sites would be limited to basic safety and security requirements, and shielded to direct light only downwards towards objects requiring illumination to minimize halo and spillover effects outside of the property boundaries. The lights would be downcast, cut-off type fixtures with non-glare finishes, and controlled by photocells. Lights would provide good color with natural light qualities with minimum intensity with adequate strength for security, safety, and personnel access. The lights would comply with the Illuminating Engineering Society industry standards for light source and luminaire measurements and testing methods and the 2018 International Dark Sky Park Program Guidelines.</p>	Phil Ryan	5/27/2020	Responded
S1.02	2/26/20	Jim Wallace	<p>Existing east-west surface routes from 1-5 to the intakes are significantly impaired. All three roads shown on Page 1 are primarily constructed on levees and all are near or adjacent to designated wildlife areas. These levee roads were never intended to carry the type or numbers of trucks that will be used during the project. Additionally, all three roads are "commuter" routes for Delta workers and are impacted by redirected traffic from 1-5 - Google maps have made it worse. Linear project features, such as roads, always pose special problems and in the Delta road construction, maintenance and use problems are usually exacerbated by poor ground conditions, high groundwater, flooding, slow moving farm equipment, uncontrolled intersections, sight-limited vertical curves on bridges, agricultural operations (particularly during grape harvest when truck traffic is very heavy at night into the early morning), slough crossings, wetlands and variable speed limits - which are often ignored.</p>	<p>The DCA is aware of the limitations of the existing Delta roads, and is analyzing multiple routes with a range of modifications to move materials and people to and from the construction sites. The range of routes currently being considered will be discussed in more detail at the May 2020 SEC meeting.</p>	Phil Ryan	5/27/2020	Responded

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S1.03	2/26/20	Jim Wallace	I endorse the concept of pooled bus service, be it electric or diesel. The parking location for employees should be at the designated project staging areas - not new parking lots. I don't think food service trucks at the job sites are necessary. There are many mine and construction sites where construction personnel are shuttled to the work site and bring their food - it's a lunch-pail approach. Set up food concessionaires in the parking lot at the beginning of each shift. I think that DCA should advise SEC that even though employee traffic will try to be minimized there will still be significant traffic on the roads from project superintendents, specialty contractors, state inspectors, and emergency vehicles and I am sure interested professionals and vendors who will want to visit the site. It may be that project employees represent the smallest number of daily round trips.	As currently planned, the project would utilize park-and-ride lots at Consolidation Centers developed for the Delta Conveyance Project to consolidate vehicles delivering materials and people to smaller construction sites. Details related to the Consolidation Centers are still being developed; however, use of these areas for centralized food trucks have been considered. It is recognized that in addition to construction material deliveries and employees, the traffic would also include vehicles for regulatory agency and utility company staff. Access to the construction for non-construction visitors (e.g., university classes) would be regulated by the construction managers who could schedule these visits during non-peak traffic times.	Phil Ryan	5/27/2020	Responded
S1.04	2/26/20	Jim Wallace	Under "Condition of Existing Levees", is this category intended to identify areas of potential inundation? I ask because large areas in the Delta will be inundated during wet winters without suffering any levee breach. Under "Future Development", please also consider designated "Special Planning Areas" which may scattered throughout the project area, i.e., Courtland Special Planning Area. Under "Existing Water Supply Wells" please consider the effects of the drawdown (extent of drawdown curve) on the extensive dewatering at all shafts. It is likely that drawdown caused by dewatering will extend a significant distance from the shafts and may impact existing wells. Additionally it is likely, given the geology and history of subsidence in the Valley, that dewatering the shafts (and the intakes) will cause subsidence outside of the project area. I recommend that DCA establish a series of monitoring wells around the shafts which could be used to determine the extent of the drawdown curve and when accurately surveyed, would provide references for potential subsidence.	The assessment of potential tunnel shaft locations considered the relative condition of the existing levees that protect the interior land as a factor related to the potential for deep flooding, not for ponding of water or poor drainage.  "Special Planning Areas" appear to be located in or near Courtland, Locke, and Walnut Grove within Sacramento County which are areas not considered in the shaft siting studies based upon the corridor locations.  Existing water supply wells were considered as an existing feature. Prior to construction of the intakes, tunnel shafts, pumping plant, and Southern Forebay, slurry walls or diaphragm walls would be constructed around each facility to isolate the construction site from adjacent groundwater and surface water. Groundwater and surface water monitoring programs would be implemented to identify any water elevation changes due to the Delta Conveyance Project.	Graham Bradner	5/27/2020	Responded

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S1.05	2/26/20	Jim Wallace	It is not clear if DCA proposes rail spurs to each launch site or just a new siding near Lambert Road which would be served by surface transportation. Rail spurs would be very difficult since the only appropriate existing 1-5 undercrossing is at Lambert Road and constructing a sustainable spur system through the Delta would be extremely difficult and expensive to maintain. A rail siding near Lambert and Franklin Roads would probably be at least 2-miles long, require at least one at grade road crossing and would probably be part of a larger staging area. It is likely that surface disturbance would exceed 300 to 400 acres. Although I agree with rail transport, I am slow to endorse significant surface disturbance which is likely to become a permanent feature.	As currently planned, the Rail-Served Materials Depot would be located parallel to Franklin Boulevard between Twin Cities Road and a location north of Dierssen Road. The rail siding area would be part of the Consolidation Center which would also include RTM and tunnel segment storage. These facilities would be removed following construction. RTM would be moved from the tunnel launch shaft on Glanville Tract (to the west of Interstate 5) to the Consolidation Center with a conveyor belt.	Jim Lorenzen	5/27/2020	Responded
S1.06	2/26/20	Jim Wallace	Throughout the history of through-Delta conveyance projects - BDCP, WaterFix - the project proponents have tried to sell Delta farmers, reclamation districts, water agencies and communities on the benefits of the RTM. I wish DWR/DCA would quit insulting us and just call it what it is - muck, tunnel spoils, waste material. OK, having said that, my guess is that material extracted from the shafts and the tunnel will have limited value as an economically viable reusable material. If the material is to be used in the construction of the intermediate and/or southern forebays, it will have to meet spec for a 30-foot (+/-) high earthen structure, containing more than 5 AF, and is subject to California Division of Dam Safety design and construction standards. As confident as DCA appears to be in the quality of the material I doubt that they would say with certainty that they could design and build qualified structures with what they know now. I find it hard to understand how DCA, or DWR, can assess the viability of a homogenized waste material as being a structurally acceptable construction material. Likewise, assessing the engineering qualities of variable geologic material deposited through a 30-mile estuary deposit tunnel horizon seems overly optimistic. I recommend a serious inferential analysis to determine an alternative use or off-site destination for the tunnel material and as a favor to all of us drop the term RTM and call it what it is.	The embankments at the Southern Forebay would be constructed in the same manner as other Delta levees with a clay core. The clay material would not be planned to be RTM, but would be excavated from onsite deposits or purchased from existing commercial local quarries. The RTM which is anticipated to consist of sands, silts, and clays and would be placed on the waterside and landside of the forebay embankments. Additional analyses will be conducted as new geotechnical information becomes available.	Phil Ryan	5/27/2020	Responded

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S1.07	2/26/20	Jim Wallace	I would like a discussion regarding the shaft site dewatering. The dewatering process will create a significant amount of water that may have to be pumped into temporary detention facilities before it is discharged into the appropriate waterway. I'd like to know what pumping rate DCA anticipates, this would help inform what other construction-related infrastructure will be needed at each shaft site. I'd also like a discussion about current NOPES water quality requirements and where the discharged water is likely to flow given such low surface water channel gradients.	Water storage tanks would be located at the intake, tunnel shaft, pumping plant, and Southern Forebay sites to reuse most of the dewatering flows for dust control and concrete, slurry, or grout production at the construction site. This would require on-site water treatment facilities to treat the dewatering flows prior to conveyance into the storage tanks. Flows that cannot be stored for reuse due to dewatering flow production schedules would need to be discharged to adjacent waterways. A National Pollutant Discharge Elimination System (NPDES) permit would be required for all discharges and would regulate flows and water quality. It is anticipated that some level of water treatment would be required, including sediment removal.	Phil Ryan	5/27/2020	Responded
S1.08	2/26/20	David Gloski	I would defer to the locals. However I would like one more thing considered. I believe one of the intake areas should be left as a park/picnic/marina/education center. With that in mind for the end, would one site be better than the other? Would it be better to be close to Hood for Hood to benefit for weekend vendors or held with other business?	The DCA is in the process of collecting suggestions and ideas on community benefits and site reuse as part of the project. When the DCA has compiled this information, we look forward to discussions with the communities about community benefits and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in the Delta.	Gwen Buchholz	5/27/2020	Responded
S1.09	2/26/20	David Gloski	Would these busses keep workers from engaging with Hood businesses? Is that good or bad?	At this time, the potential for effect of workers on local businesses in Hood has not been identified at this time. In previous studies, local Delta businesses provided comments that additional business from construction workers could be beneficial. However, if the additional business resulted in loss of existing patrons due to traffic and business congestion, the effects may not be beneficial especially after the construction activities. Changes in local and regional economics due to implementation of the alternatives will be analyzed in the EIR.	Jim Lorenzen	5/27/2020	Responded
S1.10	2/26/20	David Gloski	Highly recommend developing a way to leverage the river and use these facilities in a recreational way later	The DCA is in the process of collecting suggestions and ideas on community benefits and site reuse as part of the project. When the DCA has compiled this information, we look forward to discussions with the communities about community benefits and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in the Delta.	Phil Ryan	5/27/2020	Responded
S1.11	2/26/20	David Gloski	The final site needs to be part of a park/recreational area. Consider benefits to people and wildlife at the end.	The DCA is in the process of collecting suggestions and ideas on community collateral/benefits as part of the project. When the DCA has compiled this information, we look forward to discussions with the communities about community collateral and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in the Delta.	Gwen Buchholz	5/27/2020	Responded
S1.12	2/26/20	David Gloski	Make sure you have the flow studies to explain operations in low flow years. Minimize weekend tie-ups of the river. Build structures to accommodate good uses at the end.	DWR will be developing the operational patterns, including during low flow years, as part of the EIR.  The DCA continues to look for opportunities for co-benefit on all structures and is in the process of collecting suggestions and ideas on community benefits as part of the project which will be discussed with the communities.	Phil Ryan	5/27/2020	Responded

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S1.13	2/26/20	David Gloski	<p>I question whether you want construction considerations to be more than twice as important as 2 of the other three categories and nearly twice as important for the third! If the four categories are of equal importance, your ranking system is flawed.</p> <p>I believe a high-level environmental complexity grade should be added. DWR does CEQA but DCA cannot just make believe environmental doesn't exist in site ranking.</p> <p>Should Geotech have aquifer effects in the ranking?</p>	<p>"Each sub-category should be considered as a separate factor. The four broad categories used in the tunnel shaft siting were generalized groupings, and are not intended to be equally represented in the siting study. At this stage of project, construction considerations are extremely important as they relate the constructability and viability of various sites.</p> <p>Consideration of environmental impacts is addressed through the CEQA process, whereas, the DCA shaft siting studies are focused on the engineering considerations. Shaft locations will be re-evaluated based on input from the CEQA review as part of an iterative process during preparation of the EIR, if needed.</p> <p>Geotechnical considerations are based on publically-available Delta-wide datasets. Aquifer impacts would be site-specific and should be considered using site-specific data collected during monitoring programs. Prior to construction of the tunnel shafts, slurry walls or diaphragm walls would be constructed around the shafts to isolate the construction from the surface water and groundwater.</p>	Graham Bradner	5/27/2020	Responded
S1.14	2/26/20	David Gloski	<p>For East Corridor Launch Site B, this is near Highway 4. Need to not impede Hwy 4 during commute times. Stick with rail along Highway 4 as barges and bridges could be a problem. Also, with Discovery Bay boating, the sloughs in that area are already congested with boats. Do the intake sites have launch sites with them? You said tables will be updated with refined #'s. Please date tables so we can track them. I think the public question on funding risk is important. What if this project stopped midway?</p>	<p>The proposed barge landing to serve the tunnel launch shaft Lower Roberts Island would be located along the Stockton Deep Water Ship Channel. Therefore, barges could access the barge landing without affecting the State Route 4 bridge. Due to shallow or narrow reaches along the Sacramento River between Rio Vista and Walnut Grove, barge landings would not be included for intake construction.</p>	Jim Lorenzen	5/27/2020	Responded
S1.15	2/26/20	David Gloski	<p>Could be valuable to Reclamation Districts. Consider an RTM bank to allow Delta Agencies to access low cost RTM for levee work.</p>	<p>The DCA would like to work with the reclamation districts to establish an approach to provide RTM for future levee work.</p>	Phil Ryan	5/27/2020	Responded
S1.16	2/26/20	David Gloski	<p>Do the segments change in shape depending on tunnel diameter? How are underground corners handled with the segments?</p>	<p>Each segment ring would be tapered. Segment pieces that would form the ring would be rotated into various configurations to form a curve in the tunnel.</p>	John Caulfield	5/27/2020	Responded

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S1.17	2/26/20	Barbara Barrigan-Parrilla	Tribal recommendation take precedence because the Delta contains the remains of their ancestors and is a place of spiritual significance. California tribes are connected for cultural & economic reasons to healthy salmon runs, which will do worse with any of the three intakes. In regard to protection of communities, Delta engineers can make the best land/levee assessment as to the viability of placing intakes on these sites & the increased flood threat to communities. In addition, economic productivity of each site for the region should also be evaluated in any final decision. We see site 5 as the least objectionable (following the recommendation of the tribes); however, we see destroying seven generation farms equally tragic to the destruction of spiritual places of importance to California tribes.	The DCA considered potential interferences with existing development, including farms, in the identification of intake locations. As discussed at the December 2019 and January 2020 SEC meetings, Intakes 2, 3, and 5 would impact fewer existing developments.	Gwen Buchholz	5/27/2020	Responded
S1.18	2/26/20	Barbara Barrigan-Parrilla	It is our understanding that where or how to build a road in the Delta will require Army Corps of Engineer permits for wetlands. In addition, landowners may not be willing to sell. Our recommendation would be to pick the closest route to the chosen intake, ensure that permits will be approved, and work with neighbors first before starting eminent domain processes to see if a satisfactory route can be established for the majority of parties. As we said intake #5 is the least objectionable, then the process would be about running the most direct route to that intake site. Our question: would the DCA be better buying out farms for the corridor and intake site and making people financially whole for the loss of businesses, homes, future revenues, etc. and figuring out a way to honor their legacy in the Delta so that their families are remembered? Making people live through 15 plus years of construction impacts while impeding farming causing revenue losses, and taking away pieces of land feels cruel. We believe impacted farms will fail. The community will see each day of work as an assault on their lives, and the tension between parties and the possibility of conflict will be extreme. Perhaps it is better for offers of a buyout that will let people rebuild their lives well? We don't know the answer to that question, and would not engage in such a conversation with community members. It is not our place; it would be presumptuous. Such discussion would need to happen between the DCA and landowners.	DWR (and potentially the DCA as DWR's agent) will negotiate with landowners regarding land acquisition activities at a future time in the project implementation process. The DCA will continue to work with potentially affected landowners to minimize impacts and respect the Delta. DWR will analyze potential construction-related impacts due to implementation of the alternatives as part of preparation of the EIR.	Phil Ryan	5/27/2020	Responded

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S1.19			Whether electric buses are used or not with a "park and ride" scenario, the DCA will have to bring food, medical, emergency, and other employee services to these sites because: 1) Employees won't be able to get in and out fast enough with a car or bus for a normal meal (even fast food); 2) Construction hazards, regular farming traffic etc., will require on site emergency services. It is not an either/or. It is both to mitigate construction traffic levels (on top of farm traffic) AND to protect workers and to reduce pollution.	The DCA has considered methods to provide food trucks to consolidation centers or construction sites to reduce employee vehicle trips. The DCA is aware of the limitations of the Delta roadways, and emergency response facilities and crews would be required to be provided by the Delta Conveyance Project in accordance with the requirements of California Division of Occupational Safety and Health (Cal/OSHA) at the tunnel launch shaft sites and near the intake sites. Methods to reduce traffic congestion due to the project will be discussed in detail at the May 2020 SEC meeting.	Phil Ryan	5/27/2020	Responded
S1.20	2/26/20	Barbara Barrigan-Parrilla	The barge landing would make the most sense in Hood as it was a barge site until the railroad came into the area. However, having been up and down the Sacramento River during droughts on a pleasure boat, be advised that we hit sandbars regularly. Surveys for water depth need to be completed and enough water will need to be coming down the Sac River during dry months and dry years for barging to work.	Due to shallow or narrow reaches along the Sacramento River between Rio Vista and Walnut Grove, barge landings would not be included for intake construction. Smaller deliveries of riprap or other materials to complete the levee modifications could be transported on small barges. However, the use of barges for these facilities would not require a barge landing.	Phil Ryan	5/27/2020	Responded
S1.21	2/26/20	Barbara Barrigan-Parrilla	We need to learn about the alternative to sheet piling. Regardless of noise reduction efforts/ buffers etc., Greater Sandhill Cranes would be driven out of the area and would further decline in number with such extreme noise. So we look forward to learning about what construction noise would be like using new construction techniques. We want to know about real time reporting for water quality testing during the process. We also want to know how construction will be operated when an endangered species makes itself present. Incorporating as many wildlife corridors and bike/kayaking/wildlife viewing opportunities as possible into completed design throughout the project could enhance public access while protecting species.	The DCA is continuing to evaluate methods to reduce the need for pile driving at the intake sites, and will provide information to the SEC when these analyses continue.  Water quality monitoring would be conducted in the Sacramento River upstream and downstream of the construction locations as is generally required for National Pollutant Discharge Elimination System (NPDES) permits for construction projects.  The National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife will issue permits to DWR for the operations of the facilities which will include specific actions related to protection of threatened and endangered species regulated by each of these agencies.	Phil Ryan	5/27/2020	Responded

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S1.22	2/26/20	Barbara Barrigan-Parrilla	<p>As with the intakes, we maintain that consultation should take place with California Indian Tribes regarding the cultural, spiritual significance of each site first before asking for input from general members of the SEC to pick a site. After such consultation, it would then make the most sense to consult with Delta levee engineers to understand floodplain/levee needs and to gain further understanding of soils (in addition to recommendations made by geologists) to ensure best public and worker safety outcomes. After that an evaluation should be made of impacts to protected species, and then an economic evaluation should be made as to which site would result in the greatest reduction of revenue for a county or loss of jobs. In other words, we see community ranking following this rubric.</p> <p>To that end, the rubric for picking sites by the DCA is an adequate ranking system but does not answer the questions listed in what we describe as a community rubric. We do see an effort being made to reduce pollution by choosing sites that could be managed with barges or trains, which incidentally may also lower construction costs, but to pick the correct parcel thoughtfully and correctly these other impact questions need to be answered. Taking these other items into account, we believe could also reduced construction costs by reducing needs for mitigation during construction.</p>	The DCA studies to select intake and shaft sites were focused on engineering considerations, including geotechnical conditions based upon available information and information provided by local reclamation districts. DWR will analyze potential changes due to implementation of the alternatives in the EIR, including potential changes to biological resoures and economic resources. DWR also will conduct Tribal Consultations. As the EIR progresses, it is possible that shaft locations may be re-evaluated and modified.	Graham Bradner	5/27/2020	Responded

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S1.23	2/26/20	Barbara Barrigan-Parrilla	<p>In order to construct train spurs, we believe the same type of permitting will be required as for the construction of new roads. Yes, trains are a good method for transporting materials in order to reduce pollution, but as with roads, evaluation of wetlands needs to be completed, as well as species impacts, and possibility of land acquisition from farmers. Can this be completed in time for construction. Also, the Iron Triangle in Stockton is one of the most impacted train transfer points in the west. Can it handle addition train traffic from the Port of Stockton. Waiting to talk with the Port and train authorities will add years to the project driving up costs and delays.</p> <p>Barging is a possible solution, but see earlier question. Water depth surveys would need to be completed to ensure feasibility of sites. We could not possibly determine best sites without that data.</p> <p>Last, there needs to be a full comparison of pollution estimates from trucks vs. trains vs. barges – with an understanding of what will be electric and what won't. Our greatest concern is that the combination of increased barge, train and truck traffic around the Port of Stockton could make a very fragile community an environmental wasteland. If pollution impacts cannot be mitigated, we believe communities around the Port will need indoor air filtration systems for schools, and perhaps homes on Rough and Ready Island.</p>	The DCA is currently evaluating a coordinated effort between roads, rails, and barges to deliver materials to the construction sites. As discussed at previous SEC meetings, each of these transit modes would have constraints and opportunities and would need to be implemented in a combination of activities. DWR will analyze changes in local and regional air quality due to implementation of the alternatives and develop mitigation measures to reduce significant adverse impacts as part of the EIR preparation.	Jim Lorenzen	5/27/2020	Responded

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S1.24	2/26/20	Barbara Barrigan-Parrilla	<p>We strongly disagree with the assertion that RTM will be usable. The supplemental engineering report warns the DCA to not count using the materials The Delta is filled with legacy Mercury which will methylize when it comes into contact with water filled with nitrates from agriculture – particularly on the San Joaquin side of the Delta which receives ag discharge from upstream. How can such soil be used for levee reinforcement or at an expanded forebay at Clifton Court? The State Water Resources Control Board has strict standards regarding levee materials, dredging and spoils in the Delta.</p> <p>Moreover, as RTM is transported, how will the spoils be kept from becoming airborne? Prior testing under WaterFix indicated Chromium 6 and arsenic present in soil samples.</p> <p>We simply must see the alternative data that indicates that the RTM is safe, and how much of it the DCA believes is reusable. And for the portions that are not reusable, the engineering report suggested dumping the spoils in quarries. Our question is what quarries? Where? And what will the impacts be on those groundwater systems? We simply cannot recommend dumping polluted soil somewhere else without adequate, transparent data as to content and volume.</p>	<p>Potential reuse of RTM was evaluated by collecting soil samples from within an approximate tunnel horizon and including various additives typical of tunneling operations. These samples were then laboratory tested for geotechnical properties and environmental constituents. Based on the testing performed to date, the RTM appears to meet the geotechnical specifications for embankment fill surrounding a clay core within the embankment. Environmental testing found that metal concentrations were generally consistent with background naturally occurring levels in surface soils and would not mobilize into adjacent soil or water bodies, including the Southern Forebay.</p> <p>The DCA intends to continue evaluations of potential reuse of RTM and will perform additional sampling, testing, and evaluation in the future to confirm appropriate applications. Material reuse or disposal will be in compliance with all State and federal standards.</p> <p>Transport of the RTM or any other soil material would be conducted in a manner to avoid dust issues, including the use of covered rail cars or trucks.</p>	Graham Bradner	5/27/2020	Responded
S1.25	2/26/20	Sean Wirth	The northern most intake is problematic given its proximity to the sandhill crane roost sites in north Stone Lakes. This roosting site is the most constrained by development in our region and as such the most problematic if it is abandoned due the construction of the intakes.	DWR will evaluate changes in aquatic and terrestrial resources due to construction and operations of the intakes in the EIR. As this analysis continues, it is possible that the intake locations or plans could be modified.	Gwen Buchholz	5/27/2020	Responded
S1.26	2/26/20	Sean Wirth	<p>All of the proposed haul roads look like they will be very impactful to terrestrial species, particularly roosting and foraging sandhill cranes.</p> <p>All roads within the jurisdictional boundary of the Stone Lakes National Wildlife Refuge should be avoided. The haul road choices are indicative of how destructive and disruptive this project will be for terrestrial species.</p>	Due to the location of the intakes along the Sacramento River between the confluences of the American River and Sutter Slough, it is difficult to access these sites without traveling along Hood-Franklin, Lambert, or Twin Cities Roads. The DCA is considering methods to minimize traffic congestion on these roads and will discuss roadway modifications at the May 2020 SEC meeting.	Gwen Buchholz	5/27/2020	Responded
S1.27	2/26/20	Sean Wirth	A continuous riparian zone is an extremely important goal, and it would appear to be very achievable.	The DCA would be interested in exploring improvements to the riparian corridor along the Sacramento River near the intakes.	Phil Ryan	5/27/2020	Responded

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S1.28	2/26/20	Sean Wirth	We should revisit the placement of the intakes utilizing the same input process that is being used for the launch site placement. The current placement for the intakes work for the engineering side of things, but they are disastrous for aquatic and terrestrial species.	DWR will evaluate changes in aquatic and terrestrial resources due to construction and operations of the intakes in the EIR. As this analysis continues, it is possible that the intake locations or plans could be modified.	Gwen Buchholz	5/27/2020	Responded
S1.29	2/26/20	Sean Wirth	The most important criteria to include would be diversity and density of terrestrial species with a focus on listed species, but not to the exclusion of other species. However, it would be a mistake to simply add a couple of new criteria items to the engineering rubric currently being utilized to identify "acceptable" siting locations. Doing so would likely result in an outcome similar to the intake locations, where the engineering was the primary driver for the selection of placements that worked well mechanically, but were/are extremely destructive to both aquatic and terrestrial species. We recommend that a far more comprehensive approach be utilized for siting the launching shafts and their extensive infrastructure, one that exhibits sensitivity to the important issues and concerns represented by the stakeholders in the SEC. So, beyond comments and suggestions about how to integrate terrestrial species concerns into the decision process, we will also be discussing more broadly how the decision process should work.	The DCA shaft siting studies did consider properties that are owned by agencies and entities to protect habitat, including Cosumnes River Preserve. DWR will evaluate changes in aquatic and terrestrial resources on all types of lands due to construction and operations of the intakes in the EIR. As the EIR analysis continues, it is possible that the intake locations or plans could be modified.	Graham Bradner	5/27/2020	Responded

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S1.30	2/26/20	Sean Wirth	The approach utilized in the launching shaft selection process presented to the stakeholders at the last meeting represents a reasonable foundation for a framework that could be robust enough to incorporate addition of criteria addressing stakeholder concerns. But, it would be a potentially large mistake to just add a bunch of new criteria suggested by stakeholders, weight them, and then generate a new map. With all of the new criteria, the underlying decision process of balancing all of the additional factors becomes extremely complicated, and a single new map that attempts to incorporate all of the new criteria into one depiction representing more refined siting possibilities would seem to be nothing short of magic to all but the most informed GIS experts and modelers. Therefore, we recommend that a series of additional maps be generated for informational and illustrative purposes. The first series of maps would depict siting possibilities based on the ten to fifteen mile spacing between launching shafts coupled with the criteria specific to one stakeholder category, excluding engineering concerns. This would provide an understanding of shaft placements in the absence of the engineering concerns. The second series of maps would depict the stakeholder category considered along with engineering concerns. The third would be a single map depicting the engineering concerns along with all of the stakeholder category concerns. This approach would allow a non-expert modeler to see the compromises and tradeoffs that were made in a visual format and would allow each stakeholder to see how their concerns fit into the larger decision.	The DCA shaft siting studies were limited to engineering considerations, access routes, avoidance of lands owned by agencies and entities for the protection of habitat, existing development, and existing infrastructure. Information provided by the SEC was used to modify factors related to existing development and land uses. The EIR will evaluate potential changes to the physical, biological, and human environment due to implementation of the alternatives. As the EIR analysis continues, it is possible that the shaft locations could be modified.	Graham Bradner	5/27/2020	Responded
S1.31	2/26/20	Sean Wirth	A program like ESRI GIS hotspot analysis should be used to identify hotspots and then a decision making tool, like MARXAN, should be used to run a huge number of permutations to expose possible efficiencies - this should be done for all three classes of additional maps that we are suggesting. The stakeholders should be provided all information used for weighting criteria, the decision-making software utilized, and what specific data/GIS layers were used. (see attached multi-page response for more info)	The GIS was actually used to identify different types of land uses, understand access routes, and determine distances between shaft locations. The comparison of the options was conducted in an Excel-based tool. The results of the shaft siting studies will be compiled in the Engineering Project Report in a manner that will help understand how the different factors were analyzed with the associated weighting criteria.	Graham Bradner	5/27/2020	Responded

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S1.32	2/26/20	Cecille Giacom	The external conveyance of water from the Delta instead of through the estuary, will destroy native species habitat, Delta farms and communities and the cultural heritage therein, as well as surrounding natural resources. Thus, the three proposed sites, as components of the external conveyance project, are unacceptable because they will result in unnecessary destruction to the Delta estuary and surrounding areas.	DWR is responsible for development of the overall Delta Conveyance concept and development of the operational plan. The DCA is preparing engineering information related to construction of the facility options. The EIR will evaluate potential changes in the Delta estuarine conditions, Delta habitat, Delta farms and communities, and cultural resources related to implementation of the alternatives. That information will be considered by the DCA during finalization of engineering plans.	Gwen Buchholz	5/27/2020	Responded
S1.33	2/26/20	Cecille Giacom	Impacts of trucking would be substantially destructive to the farms, private properties and wildlife habitat of the sites. More research and actual data concerning this issue is needed before decisions governing trucking on this scale can be considered.	Potential truck routes and road modifications will be discussed in more detail at the May 2020 SEC meeting.	Jim Lorenzen	5/27/2020	Responded
S1.34	2/26/20	Cecille Giacom	Because trucks moving material, equipment, etc. will create the greatest impact, it is doubtful that carpooling employees to and from the site will effectively mitigate this.	The construction traffic plans involves both movement of materials and employees. Almost 200 employees could be present at some construction sites, such as the intakes. Therefore, carpooling would be necessary to reduce traffic on access roads and because adequate space for parking would require larger construction sites.	Jim Lorenzen	5/27/2020	Responded
S1.35	2/26/20	Cecille Giacom	Barge traffic of this frequency and magnitude will substantially clog and pollute the Sacramento River rendering it unsafe for other craft and the species existing there.	Barge traffic would be focused on moving goods and materials either to Bouldin Island under the Central Corridor option or Lower Roberts Island under the Eastern Corridor option. Access to Bouldin Island from the Port of West Sacramento, Port of Antioch, or ports on San Francisco or San Pablo bays would use portions of the lower Sacramento River. Access to Bouldin Island from the Port of Stockton or access to Lower Roberts Island from any of these ports would use the Stockton Deep Water Ship Channel/San Joaquin River.	Gwen Buchholz	5/27/2020	Responded
S1.36	2/26/20	Cecille Giacom	Layout needs to be entirely redesigned to accommodate through-Delta estuary conveyance, eliminating the need for grading of the final site. This will preserve, intact, the existing wildlife corridor and habitat as well as the cultural heritage and Delta communities. The most viable way to convey water with the least destructive effects is through the estuary. There is ample data to this effect, supported by independent scientific studies previously completed.	This comment is suggesting an alternative to the Proposed Project that DWR identified in the Notice of Preparation. DWR is considering alternatives to the Proposed Project as part of the development of the EIR, and will identify a range of reasonable alternatives that meet the project objectives and could reduce the significant environmental impacts of the Proposed Project. The DCA will then design facilities related to these alternatives. Alternative concepts should be submitted to DWR through the CEQA process.	Carrie Buckman	5/27/2020	Responded
S1.37	2/26/20	Cecille Giacom	The actual effects of boring such large launch shafts in largely unknown soils to the depths proposed is not supported by sufficient study and data. More research and data is needed in order to address this question.	Additional geotechnical investigations are planned for the next several years to further understand conditions along the tunnel alignment and at the tunnel shaft locations. Engineering design criteria would be modified as the geotechnical conditions became more fully understood.	Graham Bradner	5/27/2020	Responded

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S1.38	2/26/20	Michael Moran	<p>Preferred: CE5 2+ miles from Courtland, 1+mile from Hood, 1+ mile from Stone Lakes NWR (National Wildlife Refuge). Most flexible access. All vehicles can be divided onto different roads or redirected to most nimbly dilute/reduce impacts and address local conditions. Possible to avoid Hood altogether.</p> <p>Least Preferred: CE2 Though distant from Hood (positive), single access minimizes flexibility to address impacts. Closest to Stone Lakes NWR, requires all traffic to run along edge of NWR. Requires access/routing through edge of Hood. Place second access road.</p> <p>Middle: CE3 Less impactful on Stone Lakes and shorter route than CE2, shares negative traits of CE2. Place second access road.</p>	The DCA appreciates this information and will include it in the ongoing analysis.	Jim Lorenzen	5/27/2020	Responded
S1.39	2/26/20	Michael Moran	Establish truck routes as far away as possible from Stone Lakes NWR & off levee.	The DCA access routes were developed to minimize the use of levee roads and avoid land use changes to refuges, preserves, and conservation areas.	Jim Lorenzen	5/27/2020	Responded
S1.40	2/26/20	Michael Moran	This is a great opportunity to provide, model and support green transportation, as well as local food and service providers. CE5 provides most flexibility to divide and dilute local impacts. Provide communities (and/or post) work, bus and service vehicle schedules. If electric bus charging stations are located at staging areas, work to convert to public use to meet state charging station goals. If electric bus charging stations are located at staging areas, work to convert to public use to meet state charging station goals.	Electric charging stations, possibly powered by solar panels, would be considered for the consolidation centers where materials and people would be transferred to hybrid or electric vehicles for consolidated transport to the construction sites.	Phil Ryan	5/27/2020	Responded
S1.41	2/26/20	Michael Moran	<p>I favor a barge option on-site of intake construction. Since in-river alterations are already happening, this minimizes the footprint. I do not favor using one in Hood as it would require truck traffic in the town, something to avoid.</p> <p>A well-coordinated combination of all three (rail, truck, barge) is worth exploring. Surveying road, river, RR crossing traffic can guide best practices (pardon me if this is standard operating procedure already!). Although it looks like work is limited to weekdays (is that right?), barges may be less impactful on river traffic on weekdays (fewer boaters) or during vehicle am/pm "rush hours) and trucks on weekdays at low-traffic times. Coordinate with local schools (buses, cars, deliveries) businesses, recreation providers and first responders, as well as local wildlife use patterns.</p>	<p>Due to shallow or narrow reaches along the Sacramento River between Rio Vista and Walnut Grove, barge landings would not be included for intake construction. Smaller deliveries of riprap or other materials to complete the levee modifications could be transported on small barges. However, the use of barges for these facilities would not require a barge landing.</p> <p>There are no active railroads near the intake sites. The DCA considered re-activating the abandoned railroad adjacent to the intake sites. However in a recent study to reactivate this railroad, the California Parks and Recreation Department decided to cancel further evaluations due to potential impacts on habitat and communities. Use of the rail-served materials depot near Interstate 5 and Twin Cities Road would be used to consolidate materials and employees into transit vehicles to reduce traffic on north Delta roads.</p>	Phil Ryan	5/27/2020	Responded

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S1.42	2/26/20	Michael Moran	<ul style="list-style-type: none"> <li>- Wildlife friendly landscaping (butterfly gardening, planting trees of varying maturities/sizes/purposes).</li> <li>- Portable mature trees (&amp; other plants) in planters brought to site and moved as appropriate during project. Planted sequentially as project components are completed.</li> <li>- Rooftop planting/living roof</li> <li>- Minimize hardscapes</li> <li>- Bat, bird boxes</li> <li>- Restore function of riparian corridor lost to construction on nearby lowland to mimic corridor.</li> </ul> <p>Though not wildlife related, consider art on tall structures</p>	As DCA continues to develop the facility plans, these ideas could be included in the final landscape design plans for constructed facilities.	Phil Ryan	5/27/2020	Responded
S1.43	2/26/20	Michael Moran	<p>Overall, I like the exhibition of the siting methodology. It shows nothing is perfect, but prioritization of factors can produce clarity and preferred site/s.</p> <p>Can DCA confirm comprehensive consideration of significant (state recognized and other) sites of Native Peoples? Such sites may be assumed to be included in the matrix within the cultural feature grouping including houses, cemeteries, etc. I realize it is not a best practice to draw attention to such sites, even (especially?) in a project document. Though the state has listings of archeological sites, they are not public (State Historic Preservation Office- SHPO) and these, among other culturally significant sites in the Delta are thought by some to be under reported.</p>	DWR is conducting the Tribal Consultation activities and will evaluate potential changes to cultural and historical resources due to implementation of the alternatives as part of the EIR.	Graham Bradner	5/27/2020	Responded

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S1.44	2/26/20	Michael Moran	<p>Central Alignment- not preferred</p> <p>Launch Site A Consider keeping site north of Twin Cities Road to keep significant buffer for Delta Meadows State Park. Coordinate with State Parks re park-sponsored canoe trips in the Meadows.</p> <p>Launch Site B The traffic on, and condition of, Highway 12 makes me question its capacity to accommodate added project traffic. Access to the San Joaquin River on the west side of Bouldin makes barging attractive, but that river reach is a funnel point for boating traffic from Bethel Island and Frank's Tract (and elsewhere). CA State Dept of Parks and Recreation is currently working with citizens and other stakeholders in a process very similar to the DCA SEC called Franks Tract Futures. Though the FTF project may be a good fill (RTM) candidate, adding barge traffic to that area, even if the barge station is on Little Potato Slough, requires coordination with FTF for effectiveness and to address public perception concerns.</p> <p>Southern Forebay- no comment</p> <p>Eastern Alignment- preferred (Please note spelling: Rindge Tract)</p> <p>Launch Site A Keep footprint as far south as possible minimizing impact on Cosumnes River Preserve</p>	These comments will be added to the considerations in the ongoing development of the Central and Eastern corridors.	Graham Bradner	5/27/2020	Responded
S1.45	2/26/20	Michael Moran	Barges- schedule as in-river conditions- tides, fisheries, recreation, flow permit. Publicize barge schedules (as possible).	Barge operations would be subject to changes in river conditions, tides, wind, and recreational and commercial navigation traffic. Barge traffic along the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel would operate in accordance with the requirements of the U.S. Army Corps of Engineers and the Port of West Sacramento and Port of Stockton, respectively. In addition, the barges and the associated tugboats would operate in accordance with requirements of the U.S. Coast Guard and the Division of Boating and Waterways of the California Department of Parks and Recreation. Notifications would be provided to the U.S. Coast Guard and local marinas.	Jim Lorenzen	5/27/2020	Responded
S1.46	2/26/20	Michael Moran	Jersey Island, Franks Tract Futures, ACOE proposal for Big Break wetland creation, MWD islands	Future use of RTM and other excavated soil materials for habitat restoration will be considered as the project concepts are developed by DCA and analyzed in the EIR.	Gwen Buchholz	5/27/2020	Responded

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S1.47	2/26/20	Michael Moran	<p>Assess existing traffic, seasonal, event &amp; other patterns (car counters?). Divide traffic, employee parking into multiple access points to minimize impact on each road. Assign vendors/ contractors/ service vehicles which road which day to minimize impacts. Cut additional road(s) as necessary to accommodate targeted traffic &amp; ensure at least 2 access routes.</p> <p>Provide Delta and project interpretation at all facilities and in between (wayside), incorporate controversy. Ensure adequate parking.</p> <p>Work with Delta Protection Commission to assist their ongoing efforts of signage, Heritage Area.</p> <p>Art/murals on facilities ala West Sacramento and Oakley water tanks.</p> <p>Possible to remove roads post-project as appropriate?</p> <p>For worksites near Delta attractions leave (or build) project picnic, parking, lighting, infrastructure- work with local communities for best converted facility use.</p> <p>Turn employee lots to park &amp; ride, interpretive stops</p> <p>Project roads gated &amp; staffed to control/minimize traffic</p> <p>Semipermeable hardening where appropriate</p> <p>New barge site(s) will be new on-shore infrastructure- can these be undone?</p> <p>Ongoing coordination with local communities: School schedules, fair schedules, harvest schedules, meetings with farmers re driving</p>	<p>DCA was scheduled to conduct traffic counts. However, with the implementation of "shelter in place," it was decided to delay traffic counts. At this time, DCA is analyzing traffic patterns using existing information and will discuss this information at the May 2020 SEC meeting. The DCA did create a calendar of recurring events to be considered related to community traffic conditions. During construction, cooperative meetings with the communities could be implemented to reduce construction activities during weekend events, including Friday night activities.</p> <p>The DCA is in the process of collecting suggestions and ideas on community collateral/benefits as part of the project. When the DCA is compiles this information, we look forward to discussions with the communities about community collateral including the community's vision , and how the DCA can be a part of the vision, and avoid duplication of efforts while working with other groups and individuals also interested in the Delta. The DCA and DWR has been and will continue to coordinate with the Delta Protection Commission.</p> <p>Many of facilities at the construction sites, including barge landings, would be removed following construction and the site would be restored, potentially for community uses or habitat.</p>	Gwen Buchholz	5/27/2020	Responded

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#### S1.31 Attachment

Terrestrial Species Criteria for refining launching site placements

The most important criteria to include would be diversity and density of terrestrial species with a focus on listed species, but not to the exclusion of other species. However, it would be a mistake to simply add a couple of new criteria items to the engineering rubric currently being utilized to identify “acceptable” siting locations. Doing so would likely result in an outcome similar to the intake locations, where the engineering was the primary driver for the selection of placements that worked well mechanically, but were/are extremely destructive to both aquatic and terrestrial species. We recommend that a far more comprehensive approach be utilized for siting the launching shafts and their extensive infrastructure, one that exhibits sensitivity to the important issues and concerns represented by the stakeholders in the SEC. So, beyond comments and suggestions about how to integrate terrestrial species concerns into the decision process, we will also be discussing more broadly how the decision process should work.

The approach utilized in the launching shaft selection process presented to the stakeholders at the last meeting represents a reasonable foundation for a framework that could be robust enough to incorporate addition of criteria addressing stakeholder concerns. But, it would be a potentially large mistake to just add a bunch of new criteria suggested by stakeholders, weight them, and then generate a new map. With all of the new criteria, the underlying decision process of balancing all of the additional factors becomes extremely complicated, and a single new map that attempts to incorporate all of the new criteria into one depiction representing more refined siting possibilities would seem to be nothing short of magic to all but the most informed GIS experts and modelers. Therefore, we recommend that a series of additional maps be generated for informational and illustrative purposes. The first series of maps would depict siting possibilities based on the ten to fifteen mile spacing between launching shafts coupled with the criteria specific to one stakeholder category, excluding engineering concerns. This would provide an understanding of shaft placements in the absence of the engineering concerns. The second series of maps would depict the stakeholder category considered along with engineering concerns. The third would be a single map depicting the engineering concerns along with all of the stakeholder category concerns. This approach would allow a non-expert modeler to see the compromises and tradeoffs that were made in a visual format and would allow each stakeholder to see how their concerns fit into the larger decision.

A program like ESRI GIS hotspot analysis should be used to identify hotspots and then a decision making tool, like MARXAN, should be used to run a huge number of permutations to expose possible efficiencies – this should be done for all three classes of additional maps that we are suggesting. The stakeholders should be provided all information used for weighting criteria, the decision-making software utilized, and what specific data/GIS layers were used. For the terrestrial species aspect of this process, we would like to be able to technically analyze your process so we can determine if further refinements might improve the final outcomes. To

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this end we will need access to the same data and GIS layers that you will use. This will also allow us to comment on possible terrestrial species data gaps.

This type of multifaceted approach, which weaves in the concerns of the stakeholders with those of the engineers, should be utilized for all considerations of the siting of any of the conveyance infrastructures. This approach would integrate stakeholder concerns while providing illustrative visual maps that demonstrate that integration.

Returning to the terrestrial species criteria, there is a lot to capture when considering diversity and density. Diversity would encompass what species are using the landscape in question, with a special focus on listed species. The CNDDDB, eBird, Stone Lakes National Wildlife Refuge census data, Cosumnes River Preserve census data, Staten Island census data, Audubon Christmas counts, literature review, SSHCP and SJMSCP species data, and habitat based analysis should all be used to distill species occurrence information into GIS layers, if they are not already in a layer, to determine which species are likely using a given portion of the landscape. The weighting of factors in this category needs to consider two components: diversity hotspots, and important habitat for specific species, which could include occurrence of very rare or no take species, nesting, roosting, or important foraging areas.

Density in the broadest sense would need to capture the numbers of individuals in a species, and across species, using a particular part of the landscape. But we must also concern ourselves with additional components like the numbers of nesting, roosting, and foraging individuals in and between species. Large numbers of nesting, roosting, or foraging species indicate the potential importance of one piece of land over another. Additional terrestrial species criteria would need to include: important corridors, as well as important locations for migratory species use.

The weighting of the various criteria is a crucial part of effectively balancing the important components that need to be considered. This reality suggests that additional maps would be very helpful in determining what the most effective weighting system should be such that the maps generated appropriately address the need for properly balanced criteria driving the prioritization of the landscape for siting. So, for the terrestrial species, having separate initial maps for diversity, density, corridors, and migratory hotspots that are subsequently blended into a single map, would be very useful in determining if the blended map appropriately highlights the most important areas to avoid. If it did not, the weighting could be appropriately adjusted.

As a final comment, though stakeholder representatives that are appropriate for their specific concerns people the SEC, they are not necessarily versed in what would make effective criteria to map to make sure their issue/s is being appropriately considered. As such, we feel that it is a responsibility of the DCA and

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DWR to provide additional expert input on what the most appropriate criteria would be to fully capture stakeholder concerns.

## RESERVE NETWORKS BASED ON RICHNESS HOTSPOTS AND REPRESENTATION VARY WITH SCALE

SUSAN A. SHRINER<sup>1</sup> KENNETH R. WILSON<sup>1</sup> AND CURTIS H. FLATHER<sup>2</sup>

<sup>1</sup>Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, Colorado 80523 USA

<sup>2</sup>U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado 80526 USA

**Abstract.** While the importance of spatial scale in ecology is well established, few studies have investigated the impact of data grain on conservation planning outcomes. In this study, we compared species richness hotspot and representation networks developed at five grain sizes. We used species distribution maps for mammals and birds developed by the Arizona and New Mexico Gap Analysis Programs (GAP) to produce 1-km<sup>2</sup>, 100-km<sup>2</sup>, 625-km<sup>2</sup>, 2500-km<sup>2</sup>, and 10 000-km<sup>2</sup> grid cell resolution distribution maps. We used these distribution maps to generate species richness and hotspot (95th quantile) maps for each taxon in each state. Species composition information at each grain size was used to develop two types of representation networks using the reserve selection software MARXAN. Reserve selection analyses were restricted to Arizona birds due to considerable computation requirements. We used MARXAN to create best reserve networks based on the minimum area required to represent each species at least once and equal area networks based on irreplaceability values. We also measured the median area of each species' distribution included in hotspot (mammals and birds of Arizona and New Mexico) and irreplaceability (Arizona birds) networks across all species.

Mean area overlap between richness hotspot reserves identified at the five grain sizes was 29% (grand mean for four within-taxon/state comparisons), mean overlap for irreplaceability reserve networks was 32%, and mean overlap for best reserve networks was 53%. Hotspots for mammals and birds showed low overlap with a mean of 30%. Comparison of hotspots and irreplaceability networks showed very low overlap with a mean of 13%. For hotspots, median species distribution area protected within reserves declined monotonically from a high of 11% for 1-km<sup>2</sup> networks down to 6% for 10 000-km<sup>2</sup> networks. Irreplaceability networks showed a similar, but more variable, pattern of decline.

This work clearly shows that map resolution has a profound effect on conservation planning outcomes and that hotspot and representation outcomes may be strikingly dissimilar. Thus, conservation planning is scale dependent, such that reserves developed using coarse-grained data do not subsume fine-grained reserves. Moreover, preserving both full species representation and species rich areas may require combined reserve design strategies.

**Key words:** biodiversity; conservation planning; grain; hotspots; map resolution; MARXAN; representation; reserve selection; selection algorithms; spatial scale, species richness.

### INTRODUCTION

Identifying and understanding biodiversity pattern in nature is a central theme in ecology and is becoming increasingly important in conservation science (Crawley and Harral 2001). Rapid human population growth and its concomitant threats to biodiversity—land conversion (Flather et al. 1997), fragmentation (Saunders et al. 1991), invasive species (Pimentel et al. 2000), and climate change (Hansen et al. 2001)—combined with scarce conservation dollars, underscore the need to protect the earth's biota quickly and efficiently. Accelerating threats

to biodiversity require rapid development of conservation plans to avert species extinctions and prevent lost opportunities due to land alteration. Further, diverse land use pressures necessitate the establishment of efficient reserve networks that minimize area requirements for protecting biodiversity.

Two of the most common strategies used to establish priority areas for targeting conservation efforts are delineation of species richness hotspots and the development of complementary reserve sets based on the notion of species representation. Both approaches rely on the creation of species richness maps developed by overlaying species distribution maps. Due to the lack of detailed data on species distributions over broad areas, species richness maps are often relatively coarse grained with the size of the minimum planning unit frequently 10000 km<sup>2</sup> or greater (e.g., Andelman and Willig 2002, Larsen and Rahbek 2003, Moore et al. 2003). Con-

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<sup>3</sup> Present address: USDA/APHIS/WS, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, Colorado 80521 USA. E-mail: shriner@cnr.colostate.edu

servation planning based on these data, and therefore the grain size of conservation planning outcomes, is often far more coarse than can be practically implemented (Pressey and Logan 1998, Hopkinson et al. 2000, Ferrier 2004); i.e., reserve sizes greater than 10 000 km<sup>2</sup> are relatively rare. While large reserves may be desirable for many reasons, land availability and increasing parcelization limit the potential size of new reserves (Hopkinson et al. 2000, Walsh et al. 2004). Andelman and Willig (2003) analyzed the size distribution of protected areas in the Western Hemisphere and found that median reserve size was 4.86 km<sup>2</sup> and fewer than 3% of reserves were larger than 5000 km<sup>2</sup>. A mismatch between the grain size underlying conservation planning analyses and the grain size of conservation implementation is problematic if conservation planning results are scale dependent such that reserve networks identified with fine-grained analysis overlap little with those identified at coarser grains.

Unfortunately, detailed species range data are not generally available over broad regions (Rahbek and Graves 2001, Andelman and Willig 2002). Therefore, ecologists have little choice but to use coarse-grained data. Rahbek and Graves (2000) report that more than 50 papers addressing biodiversity pattern have been based on distribution data at grain sizes exceeding 500 000 km<sup>2</sup>. Many authors that use coarse-grained data either implicitly assume patterns detected using coarse-grained data reflect those at other grains (Rahbek and Graves 2000, Larsen and Rahbek 2003) or fail to discuss potential consequences of extrapolating results to other scales. Nonetheless, ecologists long ago recognized scale dependencies in diversity patterns (see Rahbek and Graves 2000, He et al. 2002, and Rahbek 2005 for historical citations). Unfortunately, this scale dependence is often ignored in macro-ecological and conservation planning studies (Rahbek and Graves 2000). Despite a growing body of empirical evidence highlighting the fact that map grain affects species richness patterns (e.g., Palmer and White 1994, Stoms 1994, Stohlgren et al. 1997, Lennon et al. 2001, He et al. 2002) and the reliance of many conservation planning approaches on species richness information, discussion and analysis of the impact of map grain on conservation planning outcomes are relatively uncommon.

Many researchers and practitioners have acknowledged the need for multi-scaled approaches to conservation planning, but most conservation planning analyses are performed at a single scale. Further, the call for multi-scaled approaches is not generally coupled with a call to explicitly address the impact of data resolution on conservation planning outcomes (e.g., Donovan et al. 2000, Poiani et al. 2000, Lambeck and Hobbs 2002, Bestelmeyer et al. 2003, Groves 2003, Noss 2004). Although data availability is certainly a constraint that limits multi-scale planning applications, conservation plans cannot be appropriately implemented without an understanding of how biodiversity

attributes change across scales. Stoms (1994) showed that, while species richness maps generally maintain identifiable patterns across spatial scales, species richness is not nested across grain sizes and does not necessarily vary in predictable ways. This result is a function of the fact that species richness is nonadditive when small units are aggregated into larger units (He and Legendre 1996, Legendre and Legendre 1998, He et al. 2002) because the degree of compositional similarity between units varies when the focus is on species counts. Nesting is not expected because, as Stoms (1994) explains, the aggregation of species richness areas is the logical uniori of combined sets rather than the mean of combined sets. The fact that species richness cannot be expected to nest across data grains clearly limits our ability to generalize results across spatial scales and has important implications for conservation planning.

In this study, we investigated the spatial overlap of reserve networks developed at five grain sizes. We assessed the impact of data grain on reserve networks based on species richness hotspots and species representation by systematically developing reserve networks at each grain and then comparing the spatial overlap of those reserves. If reserve networks developed at different grain sizes show high spatial overlap, implementing conservation planning outcomes at a grain other than the analysis is tenable. However, if reserve networks do not overlap, caution must be applied when reserve networks are designed at grain sizes different from the grain of implementation. We also compared the congruence of hotspot networks developed for different taxa as well as the congruence of networks based on species richness hotspots and species representation. Coincidence of networks developed for different taxa supports the use of surrogate taxa in conservation planning whereas a lack of coincidence implies networks developed for a single taxon are unlikely to adequately protect other taxa. High spatial overlap between networks based on species richness hotspots and species representation suggests that a single conservation planning approach may meet multiple conservation goals when both species representation and protection of species-rich areas are desired. However, low spatial overlap between these two types of networks indicates conservation planners must carefully prioritize conservation goals or develop methodologies that simultaneously achieve multiple goals.

We also compared the median area protected for individual species in reserve networks developed at different map grains. The area protected for a given species is an important characteristic of reserve networks because as the amount of area protected increases, long-term persistence is likely to increase. We hypothesized that, because fine-grained maps can better match species distribution boundaries, on average, conservation planning outcomes based on fine-grained maps would result in increased area of

protection for individual species compared with outcomes based on coarse-grained maps.

#### METHODS

##### *Richness hotspot reserves*

We used species range maps for mammals and birds developed by the Arizona and New Mexico Gap Analysis Program (GAP) projects completed in 1999 and 1996, respectively (Thompson et al. 1996, Halvorson et al. 2001). While these maps undoubtedly contain errors (Dean et al. 1997), we used them as simulations of "true" communities of co-occurring species that represent a range of distribution characteristics. Our analyses required known distributions so that we can appropriately isolate the effects of grain size without confounding differences in spatial overlap due to map error.

The Arizona GAP distribution maps were available as shape files based on 90 x 90 m grids and New Mexico maps are available as 100 x 100 m rasters (the study area location is shown in the inset map for Fig. 3). We used ESRI ArcGIS 8.2 (ESRI, Redlands, California, USA) to convert each species range map for mammals and birds in each state to raster format at five different map grains: 1 x 1 km (1 km<sup>2</sup>), 10 x 10 km (100 km<sup>2</sup>), 25 x 25 km (625 km<sup>2</sup>), 50 x 50 km (2500 km<sup>2</sup>), and 100 x 100 km (10 000 km<sup>2</sup>). Grid placement was held constant across grains (i.e., each map was developed based on the same lower-left coordinates) in this and all subsequent analyses. We created distribution grids at each of the five grain sizes based on binary, i.e., presence-absence, information such that any species range overlap with a grid cell counted as distribution area. We did not use a resampling (interpolation) approach because resampling assumes information is known at finer grains and is not typical of the application of occurrence data in the generation of distribution maps.

We generated species richness maps for birds and mammals in each state at each grid cell resolution by overlaying the relevant species distribution maps. To discern potential effects of taxa-specific range characteristics on our analyses, we did not combine data across taxa. We used these species richness maps to develop hotspot maps. In general, we defined hotspots as grid cells exceeding the 95th quantile for number of species represented within a grid cell as in Prendergast et al. (1993). This criterion results in the identification of reserve networks that represent 5% of the area of the extent under investigation. However, when multiple grid cells can have the same value, quantiles occur at discrete breakpoints and do not necessarily occur precisely at the 95th quantile. In an effort to create hotspot reserve networks that were as similarly sized as possible at the different grain sizes, we chose the quantile break closest to the 95th quantile that minimized area differences between maps developed at different grain sizes. For Arizona hotspot maps, hotspots centered on the 95th quantile (range, 94.24-95.39) and for New Mexico

hotspot maps, hotspots centered on the 94th quantile (range, 93.46-94.12).

In total, we created hotspot maps for four groups: Arizona birds (279 species), New Mexico birds (324 species), Arizona mammals (129 species), and New Mexico mammals (138 species). For each group we created 20 maps representing five different grain sizes. The number of potential planning units (grid cells) varied greatly with grain size. For example, the Arizona maps ranged from 41 potential planning units for the 10 000-km<sup>2</sup> maps to 296 327 potential planning units for the 1-km<sup>2</sup> maps. For comparative purposes, it should be noted that the 100-km<sup>2</sup> map grid cells are not nested within the 625-km<sup>2</sup> map grid cells; however, all other grain size comparisons represent a nested pair.

##### *Representation reserves*

We created reserve networks for Arizona birds at five grains using the species composition maps developed in the previous section as input data for the reserve selection software **MARXAN** 1.8.2 (Ball and Possingham 2000). We focused on Arizona birds because the numerical intensity of the **MARXAN** reserve selection algorithms did not permit a comprehensive analysis across both taxa and states. Representation has become a relatively common approach to reserve selection for both terrestrial and marine systems (e.g., Leslie et al. 2003, Warman et al. 2004, Cook and Auster 2005). The basic objective of reserve selection based on representation is to attain a set representation goal for conservation features (e.g., species, populations, or vegetation types) at minimum cost, which is generally minimum area (Pressey et al. 1993, Possingham et al. 2000, Leslie et al. 2003). When reserve selection occurs over a broad area encompassing a large number of potential sites, identifying reserve configurations that efficiently meet representation goals requires computer-based methods (Possingham et al. 2000, Leslie et al. 2003).

**MARXAN** offers several spatially explicit algorithms for solving minimum representation problems (Ball and Possingham 2000). Among them, simulated annealing has been shown to perform well (Possingham et al. 2000) and to provide multiple solutions which offer flexibility for conservation planning. Simulated annealing minimizes an objective function by simulating the process of annealing metals or glass (Kirkpatrick et al. 1983, Possingham et al. 2000). The algorithm proceeds by forming an initial reserve by randomly selecting a suite of sites. Sites selected randomly (with replacement) are then added or removed from the group of sites. The value of the objective function for each new group is compared with the previous solution and is either accepted or rejected. The criterion for acceptance becomes increasingly stringent as the algorithm progresses such that initially suboptimal changes may be selected, but toward the end of the process only advantageous changes are accepted. The progressively stricter acceptance criterion allows the algorithm to

avoid local minima, increasing the likelihood that the global optimum is identified.

**MARXAN** uses simulated annealing to identify a near optimal set of reserves by minimizing an objective function (total cost) based on full representation of conservation features and other conservation criteria (species weights, economic cost of planning units, boundary length, etc.). The **MARXAN** objective function is

$$\text{total cost} = \sum_{\text{PUs}} \text{LPU costs} + \sum_{\text{PUs}} \text{BLML boundary lengths} + \sum_{\text{species}} \text{CFPF X penalty X threshold penalty}$$

where PU is planning units (grid cells), **BLM** is the boundary length modifier, and CFPF is the conservation features penalty factor. The boundary length modifier is a weighting factor that can be used to spatially aggregate planning units, the conservation feature penalty factor is the penalty associated with failing to represent a conservation feature, and the threshold penalty is a cost associated with exceeding a set maximum number of planning units or cost.

Because our goal was to compare reserve networks developed at different map grains rather than to develop actual conservation networks, we used a relatively simple set of conservation priorities. We set all conservation features (species) and planning units (grid cells) to equal weight (cost) to reflect uniform species priority and land acquisition costs. We set the representation target to a minimum of one representation of each species and we did not use a boundary length modifier to reduce fragmentation because the desired level of spatial aggregation of reserve sites would vary with spatial grain. We processed 1000 runs for each of the five grain-size data sets using simulated annealing followed by iterative improvement as the solution method. Iterative improvement removes duplicated or inessential planning units, thus improving the likelihood of identifying an optimal solution (Ball and Possingham 2000).

We created two types of reserve networks based on the **MARXAN** output. First, we identified the best reserve system for each grain size. The best reserve network for a given grain size is the best solution found across the 1 000 runs and corresponds to the minimum cost (in this case, minimum area) reserve identified that includes at least a single representation of each species. Best reserve networks prescribed at each grain size vary greatly in size with large-grained data leading to larger total reserve network area. These size differences confound interpretation of scale effects because reserves are more likely to overlap as reserve size increases. Therefore, we created a second type of representation reserve network based on irreplaceability values in order to delineate approximately equal-area reserves. In general, we defined irreplaceability networks as all grid cells exceeding the 95th quantile for irreplaceability

values. The irreplaceability score for a given planning unit is the number of times the grid cell is selected as a member of the best reserve in each of the individual 1000 runs and therefore varies from 0 to 1000. As with species richness hotspots, multiple grid cells can have the same irreplaceability value so we chose quantile breaks that minimized differences (range, 94.91-95.17).

The primary goal of representation-based reserve selection is to attain a specified number of representations of each conservation feature (species) at minimum cost (area). Therefore, in developing irreplaceability reserves we maximized species representation in the reserves even if this criterion meant choosing a grid cell with an irreplaceability score below the 95th quantile. Given area constraints, the 10 000-km<sup>2</sup> and 2500-km<sup>2</sup> irreplaceability reserves were smaller than the best reserves, so we could not achieve full species representation. The 625-km<sup>2</sup> and 100-km<sup>2</sup> irreplaceability reserves were larger than the best reserves so we first insured full species representation for these networks by selecting the best set and then adding additional grid cells to reach the 5% reserve area criterion based on irreplaceability scores. This scheme resulted in the inclusion of four grid cells with irreplaceability scores below the 95th quantile for the 625-km<sup>2</sup> reserve and a single grid cell below the 95th quantile for the 100-km<sup>2</sup> reserve. We did not develop an irreplaceability reserve network for the 1-km<sup>2</sup> grid because too few cells were selected across the 1 000 runs to meet the 5% area goal.

#### *Scale comparisons*

We examined the effects of grain size by comparing five groups of reserve networks. (1) We compared spatial overlap between species richness hotspot reserve networks developed for each grain size (four groups: Arizona birds, New Mexico birds, Arizona mammals, and New Mexico mammals). (2) We compared spatial overlap between species richness hotspot reserve networks generated for different taxa (birds vs. mammals) at each grain in each of the two states. For representation reserve networks, we compared (3) best networks developed at each grain size and (4) irreplaceability networks developed at each grain size. (5) Finally, we compared spatial overlap between species richness hotspot reserve networks and irreplaceability reserve networks.

We compared richness hotspot reserves, best reserves, and irreplaceability reserves by calculating the spatial overlap between each pair of reserve networks generated at the five scales. Hotspot and irreplaceability reserve networks represent approximately 5% of the area of the states. Because the final area of these reserve networks was not exactly 5% and because best networks produced at different grains have unequal areas, we used the area of the smaller reserve network as the denominator in overlap calculations; i.e., percentage overlap = (area of spatial overlap/area of the smaller of the two reserves) X 100. We chose the smaller area to insure that percen-

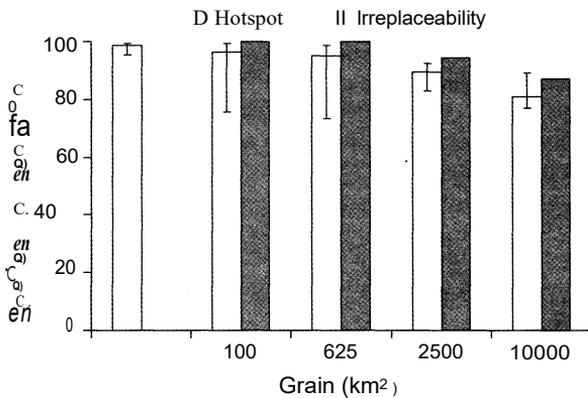


FIG. 1. Species representation in species richness hotspot reserve networks and irreplaceability reserve networks. For the species richness hotspot reserves, each bar is a mean based on representation in hotspots for Arizona birds, New Mexico birds, Arizona mammals, and New Mexico mammals. Error bars represent the minimum and maximum representation across the four groups. We did not create a 1-km<sup>2</sup> irreplaceability reserve network because too few planning units received irreplaceability scores to develop an equal area network at this grain size.

tags varied from 0 to 100. The area of best reserve networks increases with increasing grain size. Therefore, computation of percentage overlap between grain sizes for these networks represents the degree to which a smaller reserve network is nested within the larger reserve network.

For comparative purposes, we also report an adaptation of Jaccard's similarity coefficient for measuring spatial overlap (van Jaarsveld et al. 1998, Warman et al. 2004), which has been applied in previous studies. In this version of the index, Jaccard's similarity coefficient = area of spatial overlap / (area of spatial overlap + non-overlapping area of reserve one + non-overlapping area of reserve two). While this coefficient may be construed as percentage overlap, it is different from our simple percentage because this definition of overlap uses the union area of two reserve networks in the denominator rather than the area of a single reserve network. This index can be somewhat misleading as an indicator of spatial overlap when the reserve networks being compared have unequal areas. For example, in a comparison between a species richness hotspot network and a representation reserve network, Dimitrakopoulos et al. (2004) report 8.42% spatial overlap between the two networks based on Jaccard's Index. This low overlap is due to the large size differential between the two networks and obscures the fact that the richness hotspot network is completely nested within the representation network.

*Area protection for individual species*

We calculated the median area of a species' distribution that is protected within equal area reserve networks across all individual species. We used this metric as a surrogate measure of the relative likelihood of persis-

tence for individual species within a reserve network based on the assumption that the likelihood of persistence increases as species' range area (and presumably abundance) increases within a reserve network. For each richness hotspot and irreplaceability reserve network described above, we determined the area of each individual species' distribution contained within a reserve network. We converted areas to the percentage of each species' distribution area that occurred in a reserve network based on the total distribution area for a species in the state of the reserve network.

*Global reserve size*

We evaluated the size distribution of protected areas across the globe to gain an understanding of the likelihood of implementing reserve networks developed at different grain sizes. We used the 2004 World Database on Protected Areas (World Database on Protected Areas Consortium 2004) to determine the median size of reserves across the globe. The database is not a complete census of protected areas due to lack of appropriate geographic information for some areas and limitations on distributing data (World Database on Protected Areas Consortium 2004). Nonetheless, the database is the best available information on protected areas of the world. Following the lead of Andelman and Willig (2003), we limited our analyses to reserves classified by the World Conservation Union (IUCN) as category I or II because the chief purpose of these categories of protected areas is conservation. This approach excludes reserves that undoubtedly provide conservation value, such as protected areas that allow resource extraction (e.g., National Forests) while retaining some areas that provide little biodiversity value (e.g., National Monuments). However, the vast array of reserve classification systems used in different nations and variation in enforcement of particular reserves precludes easy categorization. We limited our analyses to wholly terrestrial reserves and eliminated reserves with areas < 1 ha because a large proportion of these very small reserves protect historic monuments and/or isolated geologic formations. We also deleted all duplicate records that occurred within a single country.

RESULTS

In general, species richness hotspots contained a high proportion of the total species pool for a given group and the number of species represented in richness hotspot reserves increased as grid cell size decreased (Fig. 1). Mean species representation in richness hotspot reserve networks was 81.1% (range, 76.8-89.2) for 10000-km<sup>2</sup> grid maps and 97.95% (range, 95.7-99.4) for 1-km<sup>2</sup> grid networks. Within state-taxon groups, pairwise comparisons of richness hotspot reserve networks generated from species richness maps of different grain sizes showed relatively low spatial overlap (Table 1, Appendix). Percentage overlap over all comparisons and groups ranged from 0.0% to 63.1% with a grand

TABLE 1. Pairwise comparisons of overlap for richness hotspot reserves developed at five grain sizes: 1 km<sup>2</sup>, 100 km<sup>2</sup>, 625 km<sup>2</sup>, 2500 km<sup>2</sup>, and 10000 km<sup>2</sup>.

Map comparison (km <sup>2</sup> )	Arizona		New Mexico	
	Percentage overlap	Jaccard's coefficient	Percentage overlap	Jaccard's coefficient
<b>Birds</b>				
10000, 2500	16.7	8.5	37.5	23.1
10000, 625	21.9	11.1	18.8	10.3
10000, 100	26.5	13.8	11.2	6.0
10000, 1	33.4	18.5	13.0	7.1
2500, 625	17.6	9.4	34.1	20.7
2500, 100	27.8	15.8	21.4	12.2
2500, 1	14.6	7.8	19.6	11.1
625, 100	47.1	30.6	42.7	27.5
625, 1	25.1	14.0	18.4	10.3
100, 1	32.7	19.2	29.4	17.3
Mean	26.3	14.8	24.6	14.5
<b>Mammals</b>				
10000, 2500	17.8	8.7	50.0	33.3
10000, 625	0.0	0.0	25.3	14.4
10000, 100	0.0	0.0	12.4	6.3
10 000, 1	5.1	2.4	8.7	4.3
2500, 625	54.5	34.1	56.9	39.4
2500, 100	43.4	26.5	36.1	21.0
2500, 1	27.7	15.9	21.8	11.7
625, 100	63.1	44.0	50.2	32.1
625, 1	40.5	23.6	23.9	13.1
100, 1	57.8	39.2	36.2	22.1
Mean	31.0	19.4	32.1	19.8

Note: See Appendix for associated figures.

t Percentage overlap is calculated by dividing the area of overlap by the area of the smaller reserve.

mean of 28.6%. Mean percentage overlap at different grain sizes was lower for birds (grand mean across both states= 25.6%) than for mammals (grand mean across both states= 31.6%), but was very similar across the two taxa within the two states (28.7% for Arizona and 28.6% for New Mexico).

Comparisons of spatial overlap of richness hotspot reserve networks developed for birds and mammals were based on networks developed at the same grain sizes and in the same state; e.g., the 1-km<sup>2</sup> bird richness hotspot map for Arizona was compared to the 1-km<sup>2</sup> mammal hotspot map for Arizona (Table 2, Appendix). Mean percentage overlap between mammal and bird richness hotspots across the five grains was 39.6% (range, 33.8-51.7%) in Arizona and just over half that at 20.4% (range, 0.0-35.1%) in New Mexico. Percentage overlap between the Arizona taxa showed no discernable pattern as a function of grid cell size, whereas overlap in New Mexico decreased monotonically with increasing grid cell size.

*Representation reserves*

Reserve size increased dramatically with increasing grain size for best reserve networks generated for Arizona birds (Fig. 2). Best reserve networks represent minimum area networks identified in MARXAN that contain at least a single representation of each species. The best reserve network developed from the 1-km<sup>2</sup>

TABLE 2. Spatial overlap between richness hotspot reserves developed for mammals and birds.

Grid cell size (km <sup>2</sup> )	Arizona		New Mexico	
	Percentage overlap	Jaccard's coefficient	Percentage overlap	Jaccard's coefficient
10000	41.2	26.0	0.0	0.0
2500	35.5	20.8	12.5	6.7
625	51.7	32.0	24.7	13.9
100	35.6	21.0	29.7	16.4
1	33.8	19.9	35.1	19.9
Mean	39.6	23.9	20.4	11.4

Note: See Appendix for associated figures.

t Percentage overlap was calculated by dividing the area of overlap by the area of the smaller reserve.

species composition data represents just under 0.01% (28 km<sup>2</sup>) of the area of Arizona. On the other hand, the best reserve network created from the 10 000-km<sup>2</sup> species richness data occupies nearly 20% (58 578 km<sup>2</sup>) of the state. Spatial overlap of best reserve networks developed for different grains varied from 26.6% to 69.9% with a mean of 54.5% (Fig. 3).

Irreplaceability reserve networks based on the top 5% of irreplaceability values show low spatial overlap for networks developed from species composition data at different grains (Fig. 4). Percentage overlap varied from 15.3% to 44.2% with a mean of 23.9%. Although area overlap was relatively low, reserve sites tended to cluster together in specific areas of the state. In many areas where reserve networks developed at different grain sizes did not overlap, grid cells in one network were adjacent or very near those in another network. Representation within irreplaceability reserve networks was not complete for the 10 000-km<sup>2</sup> and the 2500-km<sup>2</sup> reserves due to the area restriction imposed by selecting cells that exceeded the 95th quantile (Fig. 1). The 10 000-km<sup>2</sup> reserve set contained 243 out of 279 species, or 87.10% of the species pool and the 2500-km<sup>2</sup> reserve set represented 263 out of 279 species, or 94.27%. Because we prioritized species representation for the irreplace-

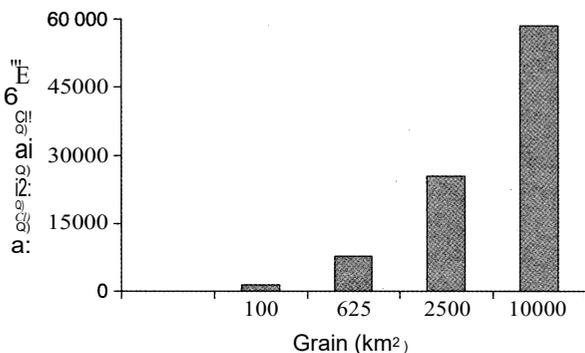


FIG. 2. Reserve area of best reserve networks developed at five grain sizes for Arizona birds. The 1-km<sup>2</sup> reserve size is 28 km<sup>2</sup>. Each best reserve network contains a minimum of one representation of each species.

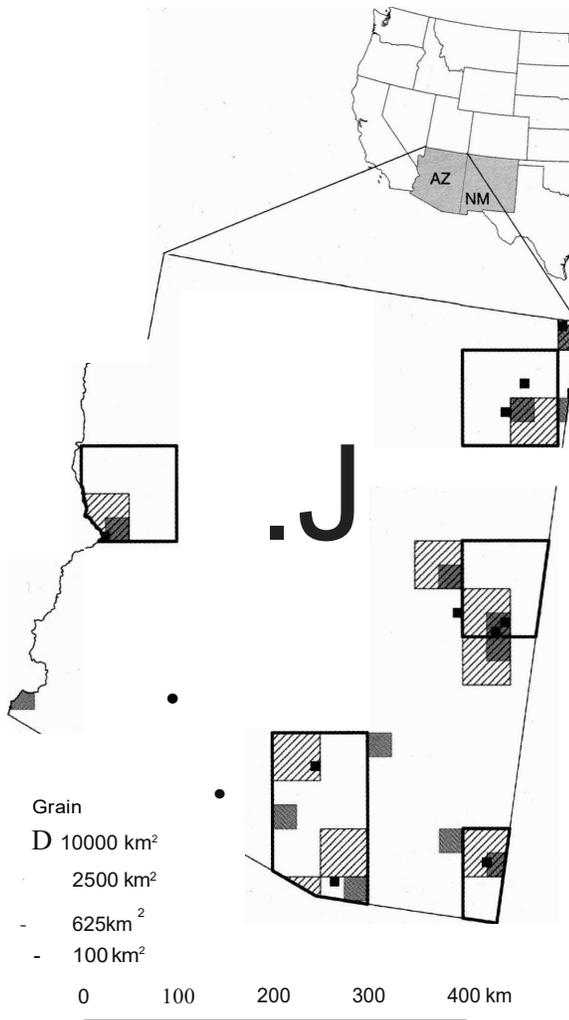


FIG. 3. The small map shows the western United States with Arizona (AZ) and New Mexico (NM) in gray. The magnified map shows the spatial overlap of best reserve networks for AZ birds based on four map grains. The 1-km<sup>2</sup> network is too small to be seen. Best reserves are the minimum area solution to full species representation found in 1000 MARXAN runs.

ability reserves, the 625-km<sup>2</sup> and 100-km<sup>2</sup> reserves had full species representation.

An assessment of irreplaceability scores showed large differences in planning unit irreplaceability as a function of grain size (Fig. 5). The 1-km<sup>2</sup> analysis showed few reserve sites have high irreplaceability values with very few planning units chosen more than 10% of the time and most chosen in fewer than 2% of the runs. In contrast, the 10 000-km<sup>2</sup> irreplaceability analysis shows very high irreplaceability scores. All seven planning units selected for the best reserve network were chosen in 100% of the runs, indicating that no other combination of sites would represent all species with minimum area. The irreplaceability analysis also showed that the simulated annealing algorithm produced fairly consis-

tent results. Across the 1000 runs for each grain size, the sites chosen for best reserves represent a relatively small portion of those available. For the 10 000-km<sup>2</sup> analysis, 75.6% of grid cells were never selected in any of the 1000 runs and for the 100-km<sup>2</sup> analysis, 99.4% of grid cells were never selected.

*Richness hotspot and irreplaceability reserve networks*

Reserve networks based on species richness hotspots showed very low spatial overlap with irreplaceability networks (Fig. 6). Mean percentage overlap was 13.1% across the four different grain size comparisons. Spatial overlap for the 100-km<sup>2</sup> networks was 10.1%, with 24.6% overlap for the 625-km<sup>2</sup> networks, 17.5% overlap for the 2500-km<sup>2</sup>, and 0.0% overlap for the 10 000-km<sup>2</sup> reserves. As expected, irreplaceability reserve networks represented more species than richness hotspot reserve networks. However, richness hotspot networks included a relatively high proportion of species, with all but five species represented in the finest grained 1-km<sup>2</sup> reserve (Fig. 1).

*Area protection for individual species*

In general, the area percentage of an individual species' range protected in richness hotspot networks declined as map grid cell size increased. The combined results across all species for each of the four groups evaluated - Arizona birds, Arizona mammals, New Mexico birds, and New Mexico mammals - showed a

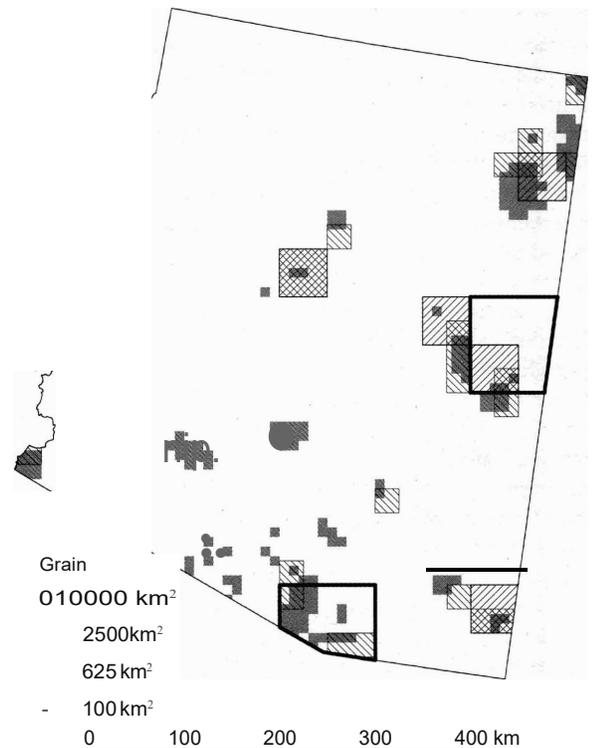


FIG. 4. Spatial overlap of irreplaceability networks for Arizona birds based on four map grains.

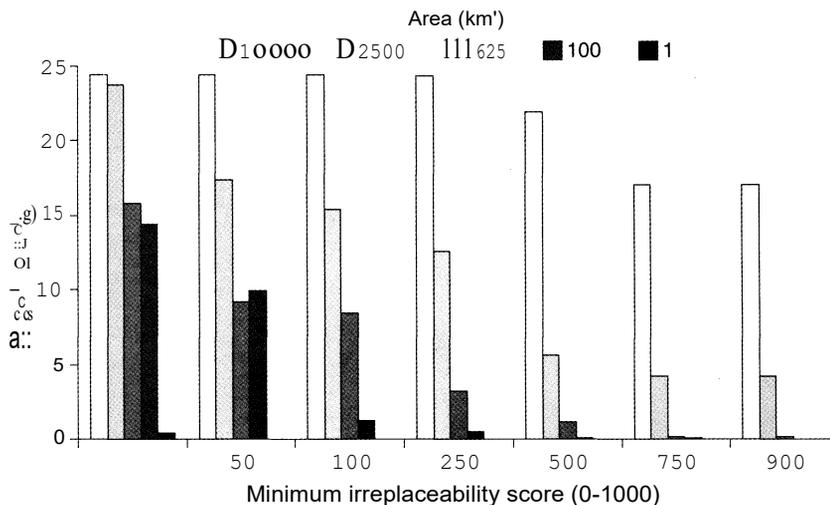


FIG. 5. Irreplaceability of planning units (grid cells) for Arizona bird networks for five map grains. Irreplaceability scores are the number of times a particular planning unit is selected in the best set for each run; e.g., a minimum score of 900 indicates that a planning unit was selected at least 900 times in the 1000 runs.

monotonic decrease from a median of 11.0% range protection in richness hotspot reserve networks created using 1-km<sup>2</sup> maps to a median of 6.4% range protection in richness hotspot reserve networks created using 10 000-km<sup>2</sup> maps (Fig. 7). Results for individual groups showed a similar pattern but were more variable, with some finer-grained networks showing lower median percentages of area protected than networks developed at coarser grains. The median range protection for individual species in irreplaceability reserve networks showed a similar pattern of range protection to the richness hotspot reserve networks (Fig. 7). Median percent range protection decreased with increasing grain size with the exception that the 100-km<sup>2</sup> reserve network showed a lower percent range protection than the 625-km<sup>2</sup> network.

*Global reserve size*

In total, we examined records for 8967 terrestrial reserves throughout the globe. Numerous reserves were < 1 km<sup>2</sup> and the largest reserve was 72 000 km<sup>2</sup>. Global reserve size exhibits a positively skewed distribution with a median size of 4.96 km<sup>2</sup>, i.e., 2.23 x 2.23 km (Fig. 8). A significant proportion of reserves are quite small; 31.2% of reserves were <1 km<sup>2</sup>. Very few reserves have been developed at the coarser grain sizes examined in this analysis. Fewer than one in 10 reserves is >625 km<sup>2</sup> and fewer than one in 100 is at least 10000 km<sup>2</sup>.

DISCUSSION

*Scale dependence*

The results of this study clearly indicate that conservation planning outcomes are scale dependent, in that reserve networks vary spatially depending on the grain of the data from which they are derived. We found that species richness hotspot reserve networks, best

representation reserve networks, and irreplaceability reserve networks all exhibited low spatial overlap between reserves generated at different map grains (Table 1, Figs. 3-4, Appendix). This lack of spatial coincidence indicates that conservation practitioners must proceed with caution when applying the results of conservation priority setting analyses developed at grains different from those at which identified reserve designs are likely to be implemented. Our results suggest that conservation planners should avoid the uncritical use of coarse-grained data to identify an efficient reserve network which is then used to locate subunits that are actually the units of reserve implementation. This type of strategy is only tenable if fine-grained reserve networks show high degrees of overlap with coarse-grained networks. Our results indicate that this is generally not true.

This study adds to the growing evidence of scale dependence of reserve design outcomes (e.g., Lennon et al. 2001, Warman et al. 2004). While Larsen and Rahbek (2003) conclude that representation networks identified at finer spatial grains are generally nested within those developed at coarser grains, their result is partially due to the tremendous size difference in the reserve networks developed at different grain sizes. The coarsest grain size reserve network they identified included 80% of their study extent, virtually ensuring the nestedness of fine-grained reserve networks. In general, comparison of fine-grained best representation networks to coarse-grained networks is positively biased since the area required to attain full species representation increases as grain size increases (Fig. 2; Larsen and Rahbek 2003, Warman et al. 2004). In our study, the smallest best reserve network was <0.01% of the area of Arizona while the largest was nearly 20% of the state. Despite this difference, we found relatively low (mean, 54.5%)

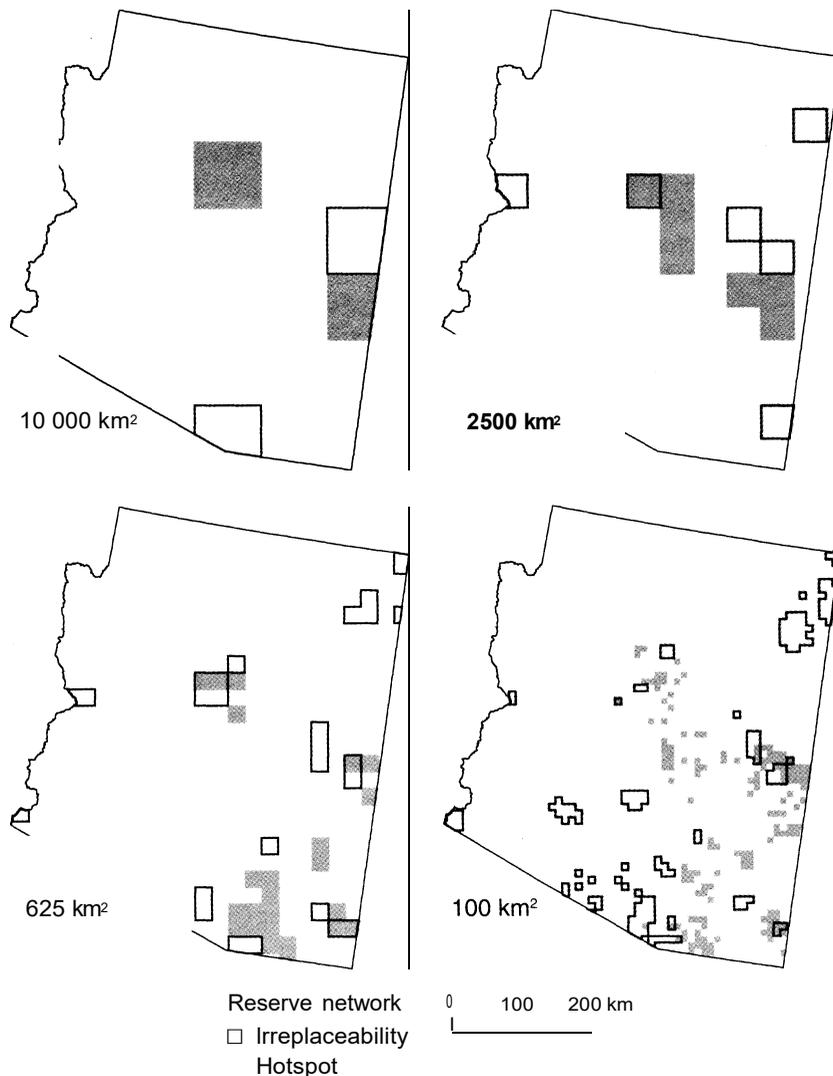


Fig. 6. Spatial overlap of richness hotspot and irreplaceability reserve networks for Arizona birds generated at four map grains.

spatial overlap between best networks developed at different grains (Fig. 3).

Our analysis of global protected areas showed that most reserves established primarily for biodiversity conservation are relatively small with a median size of 4.96 km<sup>2</sup>. This figure is remarkably similar to the median reserve size of 4.86 km<sup>2</sup> found by Andelman and Willig (2003) for the Western Hemisphere and highlights the fact that the vast majority of reserves are far smaller than the grain sizes often used to identify reserve networks. A disconnect between the grain of conservation planning and the grain of plan implementation is disconcerting given the low spatial overlap of reserve networks identified at different scales in our study. We found that, worldwide, fewer than 100 terrestrial reserves dedicated strictly to biodiversity conservation are larger than 10 000 km<sup>2</sup> and that a low percentage of global reserves have been developed at the coarser grain

sizes examined in this study (Fig. 8). Conservation plans are unlikely to be implemented at a large grain and therefore are unlikely to be efficient (Harris et al. 2005). Land availability, parcelization, and development constrain land acquisition, limiting the potential size of reserves. Consequently, efficient conservation planning requires relatively fine scale analyses that approximately match land parcel availability. Therefore, the development of fine-grained species distribution maps for designing reserve networks should be a top priority for conservation planners.

#### *Grain size trade-offs*

While data availability may be the key factor dictating the grain of reserve network analyses, conservation planners should carefully consider the trade-offs inherent in using relatively coarse- or fine-grain data (Table 3). The grain of the data used to develop a reserve

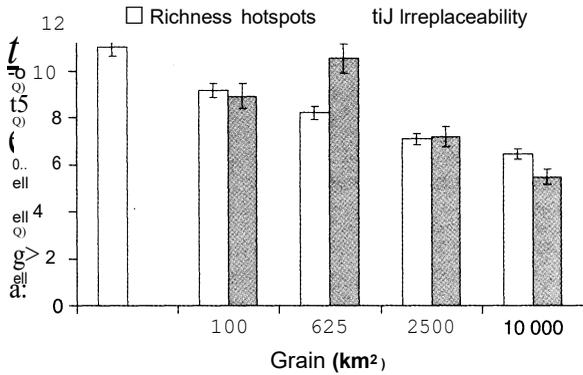


FIG. 7. Percentage of range area protected (median ± SE) in species richness hotspot and irreplaceability reserve networks. Richness hotspot values represent the means for all individual bird and mammal species. Range area is defined as the total area occupied by a species within a state, not its global distribution area. We did not create a 1-km² irreplaceability reserve network because too few planning units received irreplaceability scores to develop an equal area network at this grain size.

network impacts all aspects of conservation planning including data acquisition and quality, analysis, reserve network properties, and implementation. In addition, conservation goals may change as the grain of planning efforts changes. For example, if a reserve network is designed using fine-grained data, planners may want to impose rules to minimize fragmentation. On the other hand, if coarse-grained data are being used, planners may be more interested in spatial separation of reserves. Coarse-grained data are much more widely available than fine-grained data and are associated with lower collection costs. In addition, as grain size increases, the probability that a planning unit is actually occupied increases (Williams 1987, 1996), thus improving the likelihood a particular planning unit will provide protection for a targeted species. A further advantage of coarse-grained data is that computer analysis times are reduced. This can be an important factor in reserve selection based on optimizing algorithms such as the MARXAN analysis presented in this paper. On the other hand, coarse-grained data lead to decreased heterogeneity between planning units such that ranking sites is more difficult.

Reserve networks based on coarse-grained data lead to the identification of planning units with large areal extent and therefore benefit from the advantages generally associated with large reserve size if networks are implemented at the same grain at which they are developed. In general, large reserves have increased core areas and decreased edge-to-perimeter ratios and are more likely to maintain ecosystem function and to buffer outside threats (Noss et al. 1997). In addition, area-sensitive species and species that have large home ranges are more likely to persist in larger reserves (Diamond 1975, Gurd et al. 2001). For equal-area reserve networks in which a single population is

preserved within a reserve unit rather than multiple populations in multiple smaller reserves, potential disadvantages of larger reserves are constraints on future evolution (Rubinoff and Powell 2004) and increased vulnerability to disease transmission (Ezenwas 2004).

Fine-grained reserve networks are generally more efficient than coarse-grained networks. For both types of equal area networks that we developed, species richness hotspot and irreplaceability, the number of species represented in networks increased as grain size decreased (Fig. 1). Best representation reserve networks are also more efficient at finer grains due to the dramatic increase in total network area as grain size increases (Fig. 2; Larsen and Rahbek 2003, Warman et al. 2004). The best representation network we developed at a grain size of 10 000 km² was nearly 1 000 times larger than the one we developed at 1 km². The inefficiency of the coarse grain is primarily due to the limited degree of species co-occurrence. Two of the planning units in the best 10 000 km² set protect 87% of the species pool (243 of 279 species). The remaining four planning units comprise 43 541 km², which is enough land to create an individual 1210 km² reserve for each of the 36 species unrepresented in the two more speciose planning units. Our analysis of distribution area protected in reserve networks for individual species showed that, in general, median distribution area protected across individual species decreased as grain size increased for equal area reserves (Fig. 7). Fine-grained reserve networks, especially for species richness hotspots, are more efficient because they protect more distribution area for more species and are therefore more likely to provide long-term persistence. This result may be a function of the fact that large reserve units encompass multiple habitat types such that narrowly distributed or specialist species are unlikely to occupy the entire extent of a reserve unit. In contrast, smaller reserve units are likely to be more homogeneous so individual species are more likely to occupy a relatively larger proportion of each reserve unit. For example, a large planning unit is an inefficient

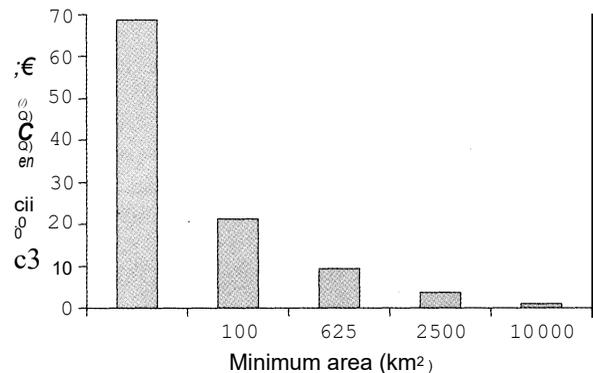


FIG. 8. Percentage of global reserves that are greater than or equal to the area of the five grain sizes used in the richness hotspot and representation reserve network analyses.

TABLE 3. Trade-offs associated with decisions about conservation planning analyses for (a) spatial grain, (b) methodology, and (c) taxonomic representation.

a) Spatial grain	
Coarse grain	Fine grain
Data characteristics	
j availability and l collection costs	<i>l availability and j collection costs</i>
j certainty about actual site occupation	<i>l certainty about actual site occupation</i>
Analysis	
<b>l computation times</b>	<b>T computation times</b>
<i>l between site heterogeneity leads to l discriminatory power</i>	<i>T between site heterogeneity leads to T discriminatory power</i>
Reserve network properties	
core area, l edge-perimeter ratio	<b>core area, T edge-perimeter ratio†</b>
protection of ecosystem function	<b>protection of ecosystem function†</b>
buffer against outside threats	<b>buffer against outside threats†</b>
persistence for area sensitive species	<i>persistence for area sensitive species†</i>
<b>persistence for fragmented or narrowly distributed species</b>	<b>persistence for fragmented or narrowly distributed species</b>
<i>l efficiency</i>	<b>T efficiency</b>
<i>l genetic variability</i>	<b>T genetic variability</b>
<i>j vulnerability to disease outbreaks</i>	<b>l vulnerability to disease outbreaks</b>
Implementation	
<i>l efficiency with analysis grain mismatch</i>	<b>T efficiency for consistent analysis grain</b>
<i>l ability to match natural boundaries</i>	<b>T ability to match natural boundaries</b>
<i>l ease in plan implementation due to i area requirements/higher costs and j jurisdictions/ownerships</i>	<b>T ease in plan implementation due to T area requirements/lower costs and l jurisdictions/ownerships</b>
b) Methodology	
Hotspot reserves	Representation reserves
<b>T mean site diversity</b>	<i>l mean site diversity</i>
<b>Does not prioritize species rare in study extent but widespread elsewhere</b>	<i>May prioritize species rare in study extent but widespread elsewhere</i>
<b>l species representation</b>	<b>T species representation</b>
<b>l flexibility</b>	<b>j flexibility</b>
c) Taxonomic representation	
Multi-taxa	Indicator taxa
<b>T species representation</b>	<b>l species representation</b>
<i>l Impractical due to data limitations</i>	<b>May be only option available</b>

Notes: Up- and down-pointing arrows indicate "increased" and "decreased," respectively. Attributes that generally have a negative effect on conservation efficiency are shown in italic type. Attributes that are supported by this study are shown in boldface type. † When sites are not aggregated.

representation of a linear (e.g., riparian) hotspot whereas multiple small planning units will better represent such a hotspot. Because reserve networks are based on underlying species distributions, fine-scale reserve networks are more likely to match distribution boundaries and therefore individual reserves are more likely to be fully occupied by resident species.

Fine-grained reserve networks also offer greater ease of implementation. Land parcel availability is much more likely to match fine-grained planning unit boundaries. Thus, implemented networks can be better matched to the designed reserve and will preserve the efficiencies inherent in the analyses. In addition, land acquisition for smaller reserve units should be facilitated by fewer jurisdictional and ownership boundaries. For best representation networks, the reduced area required for finer grained reserve networks can result in substantial economic savings over coarser grained reserve networks. Ultimately, other issues such as

extinction risk (McCarthy et al. 2005) should also play a role in determining the grain of reserve networks. For example, MARXAN allows the user to impose species specific areal and representation constraints. Incorporating these types of constraints into reserve selection analyses conducted using fine-grain data can ensure persistence for species with large area requirements or high extinction risks while maintaining the efficiencies of using fine-grain data.

*Reserve design methodology*

We found low spatial overlap between richness hotspot reserve networks and representation reserve networks at each of the spatial grains studied (Fig. 6). Williams et al. (1996) compared richness hotspot reserve networks and representation networks for British birds. Although they did not explicitly consider spatial overlap, their maps show low overlap between the two reserve types. Similar to our results, they found that

richness hotspot reserves were more clustered whereas representation networks were relatively more evenly spread throughout the study extent. In order to include species that occur exclusively in habitats with relatively low species richness, representation networks incorporate a broader spectrum of land types than richness hotspot networks.

Our finding of very low spatial overlap between richness hotspot reserves and irreplaceability reserves emphasizes the importance of carefully considering conservation goals in choosing a reserve design methodology and understanding the trade-offs associated with different methods (Table 3). Richness hotspot networks should be preferred when mean site diversity is an important goal and representation networks should be favored when full representation is a priority (Williams et al. 1996). Potential disadvantages of richness hotspot networks are that some species may remain unprotected and richness hotspots provide little flexibility in implementation. However, planners can attain some flexibility by choosing alternative sites that have slightly lower species richness values, but present fewer acquisition obstacles. Representation networks provide a great deal of flexibility in meeting conservation goals, particularly when reserves are designed using fine-grained data, because many different reserve configurations can achieve comparable representation. Irreplaceability scores show fine-grained analysis provides far more flexibility in selecting specific reserve sites because many sites have similar or identical species composition and are therefore interchangeable (Fig. 5). Although high irreplaceability scores can be interpreted to mean that a particular planning unit has high conservation value, this interpretation is confounded by scale and may be misleading for fine-grained analyses. When multiple fine-grained planning units have similar species composition they receive low irreplaceability scores because the sites are not unique. However, these planning units may be essential to attaining full species representation. Representation networks can be inefficient if they are designed for a relatively small extent because redundancies with reserves outside of the study extent become increasingly likely as the study size decreases (Erasmus et al. 1999). Another potential disadvantage of representation networks is that they can prioritize species that are rare in the study extent, but widespread elsewhere (Erasmus et al. 1999).

While most researchers have studied richness hotspot and representation networks independently, combining the approaches may allow conservation planners to simultaneously achieve these two goals. In our study, species richness hotspot networks contained a high proportion of the species pool. Conservation planners could use hotspots as a starting point for representation networks. Alternatively, species richness could be used as a weighting factor in reserve selection analyses to increase the probability that planning units with

high species richness are included in representation networks.

#### *Taxonomic surrogacy*

Comparison of species richness hotspot reserves developed for birds and mammals showed low spatial congruence between the two taxa (Table 2, Appendix). This result held for reserve networks developed for both Arizona and New Mexico at each of the data resolutions investigated and corroborates results found in other studies (e.g., Prendergast et al. 1993, van Jaarsveld et al. 1998; but see Abbitt et al. 2000). Comprehensive taxonomic analysis is undoubtedly the best method for achieving complete species representation and for identifying hotspots; however, data requirements for such analyses are tremendous and currently unavailable in most areas. Using available species as surrogates for all species is usually the only option available. Unfortunately, there is little empirical support that richness hotspot networks and representation networks overlap for diverse taxa.

#### *Conclusions*

Conservation planners cannot assume broad scale analyses predict fine-scale results. We found little evidence that coarse-grained reserves designed using either richness or representation criteria subsume reserves designed using fine-grained data. Conservation planners therefore run the risk of designing inefficient reserves if data grains used for reserve analysis are inconsistent with grains for reserve creation. The acquisition of fine-grained species distribution maps or occurrence records is therefore a high priority for effective conservation planning. Furthermore, conservation of richness hotspots and full species representation are both worthy conservation objectives so researchers should focus on developing methods that combine these dual goals.

Low spatial overlap between reserve networks developed at different spatial grains, for different taxa, and using different reserve selection methods indicates that systematic reserve design is not generally robust to spatial grain, taxonomic surrogacy, or methodology. This lack of generality in reserve design schemes suggests that conservation planners must carefully design reserve selection analyses to coincide with stated conservation goals.

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## LITERATURE CITED

- Abbitt, **R. J. F.**, J. M. Scott, and **D. S.** Wilcove. 2000. The geography of vulnerability: incorporating species geography and human development patterns into conservation planning. *Biological Conservation* 96:169-175.
- Andelman, S. J., and **M. R.** Willig. 2002. Alternative configurations of conservation reserves for Paraguayan bats: considerations of spatial scale. *Conservation Biology* 16:1352-1363.
- Andelman, S. J., and **M. R.** Willig. 2003. Present patterns and future prospects for biodiversity in the Western Hemisphere. *Ecology Letters* 6:818-824.
- Ball, I. R., and **H. P.** Possingham. 2000. **MARXAN** (v 1.8.6): marine reserve design using spatially explicit annealing: a manual prepared for the Great Barrier Reef Marine Park Authority. University of Queensland, Brisbane, Australia.
- Bestelmeyer, B. T., J. R. Miller, and J. A. Wiens. 2003. Applying species diversity theory to land management. *Ecological Applications* 13:1750-1761.
- Cook, **R.R.**, and **P. J.** Auster. 2005. Use of simulated annealing for identifying essential fish habitat in a multispecies context. *Conservation Biology* 19:876-886.
- Crawley, M. J., and J. E. Hurrell. 2001. Scale dependence in plant biodiversity. *Science* 291:864-868.
- Dean, D. J., K. R. Wilson, and C. H. Flather. 1997. Spatial error analysis of species richness for a gap analysis map. *Photogrammetric Engineering and Remote Sensing* 63:1211-1217.
- Diamond, **J.M.** 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural reserves. *Biological Conservation* 7:129-146.
- Dimitrakopoulos, **P. G.**, **D.** Memtsas, and **A. Y.** Troumbis. 2004. Questioning the effectiveness of the Natura 2000 Special Areas of Conservation strategy: the case of Crete. *Global Ecology and Biogeography* 13:199-207.
- Donovan, T. M., K. E. Freemark, B. A. Maurer, L. Petit, S. K. Robinson, and V. A. Saab. 2000. Setting local and regional objectives for the persistence of bird populations. Pages 53-59 in R. Bonney, D. N. Pashley, R. J. Cooper, and L. Niles, editors. *Strategies for bird conservation: the Partners in Flight planning process*. Proceedings RMRS-P-16. USDA Forest Service, Rocky Mountain Research Station, Ogden, Utah, USA.
- Erasmus, B. F. N., S. Freitag, K. J. Gaston, B. H. Erasmus, and A. S. van Jaarsveld. 1999. Scale and conservation planning in the real world. *Proceedings of the Royal Society of London B* 266:315-319.
- Ezenwas, V. O. 2004. Parasite infection rates of impala (*Aepyceros melampus*) in fenced game reserves in relation to reserve characteristics. *Biological Conservation* 118:397-401.
- Ferrier, S., et al. 2004. Mapping more of terrestrial biodiversity for global conservation assessment. *BioScience* 54:1 IO1-1109.
- Flather, C.H., K. R. Wilson, D. J. Dean, and W. C. McComb. 1997. Identifying gaps in conservation networks: of indicators and uncertainty in geographic-based analyses. *Ecological Applications* 7:531-542.
- Groves, C. R., and the Nature Conservancy. 2003. *Drafting a conservation blueprint: a practitioner's guide to planning for biodiversity*. Island Press, Washington, D.C., USA.
- Gurd, D. B., T. D. Nudds, and D. H. Rivard. 2001. Conservation of mammals in eastern north America wildlife reserves: how small is too small? *Conservation Biology* 15:1355-1363.
- Halvorson, W., K. A. Thomas, and L. Graham. 2001. Arizona Gap Project final report. Special Technical Report, USGS Sonoran Desert Field Station, University of Arizona, Tucson, Arizona, USA.
- Hansen, A. J., R. P. Neilson, V. H. Dale, C. H. Flather, L. R. Iverson, D. J. Currie, S. Shafer, R. Cook, and P. J. Bartlein. 2001. Global change in forests: responses of species, communities, and biomes. *BioScience* 51:765-779.
- Harris, G. M., C. N. Jenkins, and S. L. Pimm. 2005. Refining biodiversity conservation priorities. *Conservation Biology* 19:1957-1968.
- He, F., J. V. LaFrankie, and B. Song. 2002. Scale dependence of tree abundance and richness in a tropical rain forest, Malaysia. *Landscape Ecology* 17:559-568.
- He, F., and P. Legendre. 1996. On species-area relations. *American Naturalist* 148:719-737.
- Hopkinson, P., J. Evans, and R. D. Gregory. 2000. National-scale conservation assessments at an appropriate resolution. *Diversity and Distributions* 6:195-204.
- Kirkpatrick, S., C. D. Gelatt, Jr., and M. P. Vecchi. 1983. Optimization by simulated annealing. *Science* 220:671-680.
- Lambeck, **R. J.**, and **R. J.** Hobbs. 2002. Landscape and regional planning for conservation: issues and practicalities. Pages 360-380 in **K. J.** Gutzwiller, editor. *Applying landscape ecology in biological conservation*. Springer-Verlag, New York, New York, USA.
- Larsen, F. W., and C. Rahbek. 2003. Influence of scale on conservation priority setting: a test on African mammals. *Biodiversity and Conservation* 12:599-614.
- Legendre, P., and L. Legendre. 1998. *Numerical ecology*, Second edition. Elsevier Science, Amsterdam, The Netherlands.
- Lennon, J. J., P. Koleff, J. J. D. Greenwood, and K. J. Gaston. 2001. The geographical structure of British bird distributions: diversity, spatial turnover and scale. *Journal of Animal Ecology* 70:966-979.
- Leslie, **H.**, M. Ruckelshaus, I. R. Ball, S. Andelman, and **H.P.** Possingham. 2003. Using siting algorithms in the design of marine reserve networks. *Ecological Applications* 13S:S185-S198.
- McCarthy, **M. A.**, C. J. Thompson, and **H. P.** Possingham. 2005. Theory for designing nature reserves for single species. *American Naturalist* 165:250-257.
- Moore, **J. L.**, **M.** Folkmann, **A.** Balmford, **T.** Brooks, **N.** Burgess, **C.** Rahbek, **P. H.** Williams, and **J.** Kramp. 2003. Heuristic and optimal solutions for set-covering problems in conservation biology. *Ecography* 26:595-601.
- Noss, R. F. 2004. Conservation targets and information needs for regional conservation planning. *Natural Areas Journal* 24:223-231.
- Noss, **R. F.**, **M. A.** O'Connell, and **D. D.** Murphy. 1997. *The science of conservation planning*. Island Press, Washington, D.C., USA.
- Palmer, M. W., and P. S. White. 1994. Scale dependence and the species-area relationship. *American Naturalist* 144:717-740.
- Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50:53-65.
- Poiani, K. A., B. D. Richter, M. G. Anderson, and H. E. Richter. 2000. Biodiversity conservation at multiple scales: functional sites, landscapes, and networks. *BioScience* 50:133-146.
- Possingham, H. P., I. Ball, and S. Andelman. 2000. Mathematical methods for identifying representative reserve networks. Pages 291-306 in S. Ferson and M. A. Burgman, editors. *Quantitative methods in conservation biology*. Springer-Verlag, New York, New York, USA.
- Prendergast, **J. R.**, **R. M.** Quinn, **J. H.** Lawton, **B. C.** Eversham, and **D. W.** Gibbon. 1993. Rare species, the coincidence of diversity hotspots and conservation strategies. *Nature* 365:335-337.
- Pressey, **R. L.**, C. J. Humphries, **C. R.** Margules, R. I. Vane-Wright, and **P.H.** Williams. 1993. Beyond opportunism: key principles for systematic reserve selection. *Trends in Ecology and Evolution* 4:124-128.

- Pressey, R. L., and V. S. Logan. 1998. Size of selection units for future reserves and its influence on actual vs. targeted representation of features: a case study in western New South Wales. *Biological Conservation* 85:305-319.
- Rahbek, C. 2005. The role of spatial scale and the perception of large-scale species-richness patterns. *Ecology Letters* 8:224-239.
- Rahbek, C., and G. R. Graves. 2000. Detection of macroecological patterns in South American hummingbirds is affected by spatial scale. *Proceedings of the Royal Society of London Series B* 267:2259-2265.
- Rahbek, C., and G. R. Graves. 2001. Multiscale assessment of patterns of avian species richness. *Proceedings of the National Academy of Sciences (USA)* 98:4534-4539.
- Rubinoff, D., and J. A. Powell. 2004. Conservation of fragmented small populations: endemic species persistence on California's smallest channel island. *Biodiversity and Conservation* 13:2537-2550.
- Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. *Conservation Biology* 5:18-32.
- Stohlgren, T. J., G. W. Chong, M. A. Kalkhan, and L. D. Schell. 1997. Multiscale sampling of plant diversity: effects of minimum mapping unit size. *Ecology* 7:1064-1074.
- Starns, D. M. 1994. Scale dependence of species richness maps. *Professional Geographer* 46:346-358.
- Thompson, B. C., P. J. Cist, J. S. Prior-Magee, R. A. Deitner, D. L. Garber, and M. A. Hughes. 1996. Gap analysis of biological diversity conservation in New Mexico using geographic information systems. Research completion report. New Mexico Cooperative Fish and Wildlife Research Unit, Las Cruces, New Mexico, USA.
- van Jaarsveld, A. S., S. Freitag, S. L. Chown, C. Muller, S. Koch, H. Hull, C. Bellamy, M. Kruger, S. Endrody-Younga, Mervyn W. Mansell, and C. H. Scholtz. 1998. Biodiversity assessment and conservation strategies. *Science* 279:2106-2108.
- Walsh, S. J., T. P. Evans, and B. L. Turner. 2004. Population-environment interactions with an emphasis on land-use/land-cover dynamics and the role of technology. Pages 491-519 in S. D. Brunn, S. L. Cutter, and J. W. Harrington, eds. *Geography and technology*. Kluwer Academic Publishers, Boston, Massachusetts, USA.
- Warman, L. D., A. R. E. Sinclair, G. G. E. Scudder, B. Klinkenberg, and R. L. Pressey. 2004. Sensitivity of systematic reserve selection to decisions about scale, biological data, and targets: case study from southern British Columbia. *Conservation Biology* 18:655-666.
- Williams, B. K. 1987. Frequency sampling in microhistological studies, an alternative model. *Journal of Range Management* 40:109-112.
- Williams, B. K. 1996. Assessment of accuracy in the mapping of vertebrate biodiversity. *Journal of Environmental Management* 47:269-282.
- Williams, P., D. Gibbons, C. Margules, A. Rebelo, C. Humphries, and R. Pressey. 1996. A comparison of richness hotspots, rarity hotspots, and complementarity areas for conserving diversity of British birds. *Conservation Biology* 10:155-174.
- World Database on Protected Areas Consortium. 2004. World database on protected areas. World Conservation Union (IUCN) and UNEP-World Conservation Monitoring Centre (UNEP-WCMC). CD-ROM. Center for Applied Biodiversity Science, Conservation International, Washington, D.C., USA.

#### APPENDIX

Richness reserve networks for Arizona and New Mexico birds and mammals developed at five map grains. Maps show spatial overlap of reserve networks developed at different grains and spatial overlap at reserve networks developed for different taxa (*Ecological Archives* A01 6-057-A I).