Bathymetry [Contract] Consideration

To: Parties to the CSKT Compact

From: CSKT-MT Compact Implementation Technical Team

Date: Updated December 2017 **[DRAFT IV]**

Re: Proposal to contract ADCP and LIDAR lake/reservoir bathymetry mapping services

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Summary of Project

The Compact Implementation Technical Team (CITT) proposes a contract for services for bathymetric mapping of 14 Flathead Indian Irrigation Project (FIIP) reservoirs. We suggest combining Acoustic Doppler Current Profiler (ADCP) [for below the water surface] and Light Detection and Ranging (LIDAR) [for above the water surface] to yield a complete lake/reservoir survey that extends above the spillway elevations. Equivalent survey technologies should also be considered during the Request for Qualifications (RFQ)/Request for Proposals (RFP) stage.

Unlike relying solely on below water surface sonar survey, a combination of above and below water surface survey techniques allows for mapping of reservoirs during periods where the reservoir elevation is below maximum capacity. Additionally, spill way and flood-stage elevations can be mapped providing added benefit for dam safety and reservoir managers.

Deliverable final products should include one seamless digital bathymetric map file that combines the two surveys, reservoir capacity rating tables, and printable maps for each reservoir. Cursory cost estimates suggest that this can be achieved for a **not-to-exceed budget of $200,000** for the RFQ/RFP process; lower costs are anticipated. The CITT seeks agreement from the parties in advance of implementing any RFQ/RFP to ensure funding approval before solicitations. All deliverable products will be publicly available, either through the CITT website or upon request through the CITT website.

Process for Successful Contracting:

Overview of Compact & Need for Reservoir Mapping

As part of the CSKT-MT Compact (85-20-1901 MCA), the CITT was formed and charged, to develop technical proposals to improve water management on the Flathead Indian Irrigation Project (FIIP). One area of improvement is the remapping of up to 14 FIIP reservoirs that are used to store irrigation water supply for the FIIP. Several of the reservoirs have existing recreational and fisheries minimum pool elevation regulation levels, as well as modified minimum pool elevation levels as identified in the Compact.

The existing reservoir bathymetry maps used to generate stage-to-volume relationships or [reservoir] capacity-curves are uncertain in quality. Uncertainty originates from unknowns related to original development of the capacity tables and sediment inputs that may have reduced reservoir capacities over time (see photo, page 5). It is expected that staff gages and capacity-curves need recalibration. Accurate capacity-curves will help to assess and manage irrigation water supplies and enable efficient impound and release schedules. Accurate capacity-curves will help to better manage FIIP reservoirs and meet the Compact terms related to both irrigation and aquatic ecosystems. The reservoirs likely to benefit from bathymetry are tabled by min/max water surface elevation, [max] capacity, and max depth:

FIIP Reservoir	Min Elevation (FT)	Max Elevation (FT)	Capacity (AF)	Max Depth (FT)	LAT, LONG (decimal degrees)
Little Bitterroot	3898	3906.9	28000	8.9	(114.72°W, 48.11°N)
Hubbart	3140.4	3208.5	7933	68.1	(114.74°W, 47.94°N)
Upper Dry Fork	2900	2932	4015	32	(114.69°W, 47.75°N)
Lower Dry Fork	2830.5	2860	5340	29.5	(114.67°W, 47.71°N)
Black Lake	4390	4440	5200	50	(113.72°W, 47.19°N)

Lower Jocko Lake	4276	4341	6497	65	(113.75°W, 47.20°N)
Tabor	3911.5	4026	23597	114.5	(113.92°W, 47.26°N)
Mission	3341	3410.3	8490	69.3	(114.01°W, 47.32°N)
McDonald	3545	3600	8645	55	(113.98°W, 47.42°N)
Kicking Horse	3042	3063	9200	21	(114.07°W, 47.46°N)
NinePipe	2985	3011	16472	26	(114.12°W, 47.44°N)
Crow reservoir	2800	2877	10352	77	(114.22°W, 47.50°N)
Pablo	3179	3211	28400	32	(114.16°W, 47.64°N)
Twin	3061	3091.9	991	30.9	(114.08°W, 47.67°N)

Bathymetry Mapping Background

Below the water surface: Reservoir and lake bathymetry can be mapped below the surface elevation by attaching an acoustic Doppler current profiler (ADCP) to a boat, linking the equipment to a GPS platform, and surveying by traversing the reservoir in a systematic fashion. The resulting profile data is then processed to produce a digital elevation model (DEM) of the reservoir or lake, which can then be used to render many desired measurements and maps of lake characteristics such as surface area, maximum capacity, capacity-curves, length and width measures, depths, and surface area to volume relationships.

Above the water surface: Reservoir water surface and the surrounding topography can be mapped by LIDAR, which is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses – combined with other data recorded by the airborne system – generate precise, these-dimensional information about the shape of the Earth and its surface characteristics. A LIDAR instrument principally consists of a laser, a scanner, and a specialized GPS receiver. Airplanes and helicopters are the most commonly used platforms for acquiring LIDAR data over broad areas. Two types of LIDAR are topographic and bathymetric. Topographic LIDAR typically uses a near-infrared laser to map the land, while bathymetric LIDAR uses water-penetrating green light to also measure seafloor and riverbed elevations.

For the purposes of this RFQ/RFP, outreach should allow for equivalent technologies that provide 1’ or smaller contour intervals of bathymetric mapping.

Reservoir Access

Acoustic Doppler bathymetry mapping costs are reduced when motorized boats can be used. Current restrictions exclude public motorized boating on the reservoirs proposed to be measured. Fortunately, the CITT has gained verbal permission from both CSKT and USFWS reservoir managers to obtain exception to these boating restrictions, so long as aquatic invasive species prevention procedures and other special use restrictions and scheduling limitations are addressed.

Solicitation and Contracting Vehicle

This proposal envisions that CSKT will administer the contract without adding administrative or incidental fees. The CSKT will prepare the Request for Proposals in full consultation with the CITT and will adhere to CSKT procedures. A solicitation for contract for services will use a cooperative outreach through both the State of Montana and CSKT standardized RFQ/RFP procedures, with clear designation

that the CSKT will administer the contract for services. Following appropriate solicitation procedures, the CITT will review solicitations and make a recommendation to the CSKT. The CSKT will ultimately be responsible for final selection of the contractor, notification of the contractor of the award, and implementation of the contract, with the assistance of the CITT.

Contract Parameters and Estimates

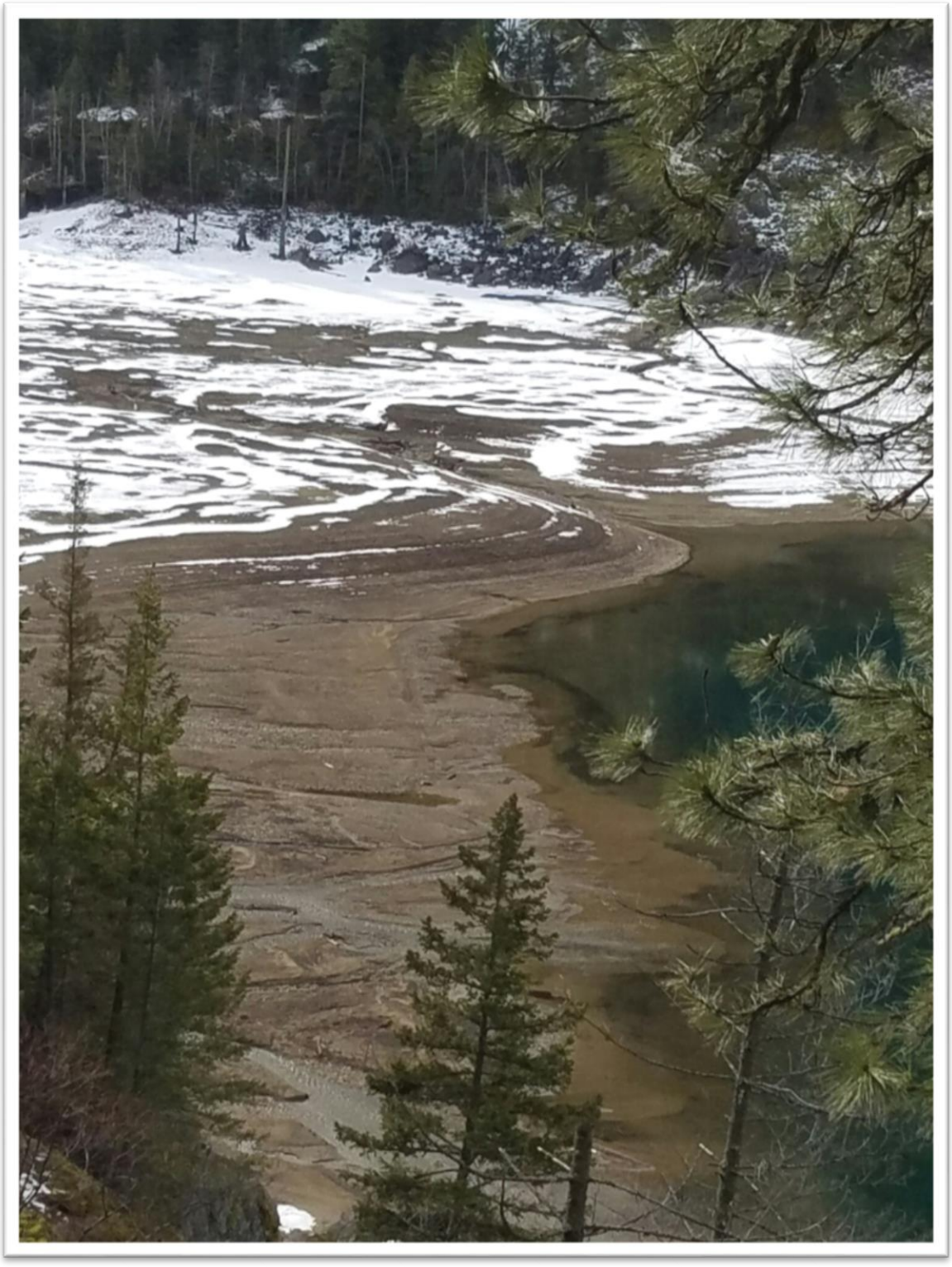
For purposes of this proposal, contracted bathymetry mapping costs have been estimated using informally provided estimates from local bathymetry mapping service providers. The estimates envision a 1' or smaller contour interval and that the contractor will improve sounding accuracy by correcting for the depth of the transducer below the water surface during mapping and for any known or estimated variation from full pool at time of mapping. All survey data will be tied to existing reservoir benchmark datum and control points provided by the FIIP. It is also assumed that FIIP will provide stage data at the time of measurement. It is assumed that the contractor will address weed issues that may hinder Doppler surveys. The contract will allow for motorized boat use and require strict adherence to all aquatic invasive species prevention procedures.

The contract should include general liability insurance to be provided by the contractor for an amount to be determined by CSKT contract procedures.

Contract Deliverables

For each of the fourteen reservoirs, the delivered products would be:

- Survey sufficient for 1 foot contour.
- A bathymetric graphic in .dxf and .dwg format in UTM coordinates, Geodetic reference system NAD 27, meters with depth in feet for each reservoir that seamlessly combines any differing methods used for survey and ties to reservoir elevation benchmarks.
- A stage storage table with surface area for each contour (acres and square meters) and volume for each incremental slice in acre-feet.
- Contractor will provide raw and corrected x, y, z spreadsheets with all of the position tagged depth soundings. Publication of individual reservoir maps.
- Timeframe for completion should be used as a ranking criteria in bid assessment, and not to exceed a period greater than two years.



McDonald Reservoir delta/sediment inputs that may affect capacity and existing capacity curves;

March 2017 photo by Seth Makepeace, CSKT Hydrologist and CITT Appointee