Weather Station Recommendations

To: Parties to the CSKT-MT Compact;
Jama Hamel, AgriMet Program Coordinator, U.S. Bureau of Reclamation; and
Corey Carmack, Tribal Assistance Program, U.S. Bureau of Reclamation

From: CSKT-MT Compact Implementation Technical Team

Date: June, 08, 2017 **[DRAFT]**

Re: Recommendation to add 3 AgriMet weather stations to the Flathead Indian Irrigation Project area

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Overview of Compact & Need for Weather Stations

As part of the CSKT-MT Compact (85-20-1901 MCA), the Compact Technical Team (CITT) was formed and charged, among other assignments, to develop and make technical recommendations to improve on-farm efficiency on the Flathead Indian Irrigation Project (FIIP). One area of improvement identified is the installation of additional AgriMet weather stations that can provide localized climate data needed to estimate crop irrigation water requirements that can be used to directly support management decisions of local agricultural producers and irrigation managers.

The CITT plans to recommend the creation and routine publication of weather and crop water requirement reports designed to support FIIP area agricultural and irrigation decisions. The reports would be public information made available through the CITT website. To provide this information, a localized weather station network of sufficient resolution to characterize variable site conditions is essential. Enhanced resolution weather station networks can also support future field-scale evapotranspiration estimates using METRIC[1] or similar techniques that correlate remote sensing with localized weather data.

AgriMet Program Background

AgriMet is a network of automatic agricultural weather stations administered and operated by the U.S. Bureau of Reclamation (USBR) and dedicated to crop water use modeling and other agricultural applications. The Flathead Indian Reservation is part of the USBR's Pacific Northwest Region. Real-time AgriMet data is transmitted from individual stations to USBR's receive- site in Boise, ID through the GOES-8 and DOMSAT satellites. Each Station transmits its data once an hour. Data collection intervals within the hourly transmit period are dependent on the specific sensor equipment at each station. Types of data collected at each station varies. The data is processed at the Boise Regional Office, then made available on the World Wide Web. Data are

[1] METRIC (Mapping Evapo Transpiration at high Resolution with Internalized Calibration) is a computer model developed by the University of Idaho that uses Landsat satellite data to computer and map evapotranspiration (ET).

reviewed daily for quality control purposes, but all numbers should be considered provisional unless officially released by appropriate BOR personnel (US BOR, 2016).

Information collected at individual stations can include:

- Average, Max, and/or Min Air Temp – Shielded and/or Unshielded Ground and/or Crop Canopy Located (F°)
- Barometric Pressure (in. HG)
- Leaf Wetness (resistance values)
- Incremental Precipitation – Heated or Non-heated Tipping Bucket (in.)
- Incremental Global Global Solar Radiation (Langley's)
- Incremental Diffuse Solar Radiation (Langley's)
- Soil Temp at 2, 4, 8, 20, and/or 40 (in.) Depth (F°)
- Average Dew Point Temp (F°)
- Average Actual Vapor Pressure (kPA)
- Relative Humidity (%)
- Average Wind Speed and/or Peak Wind Gust (mph)
- Wind Direction (degrees) and/or Cumulative Run (miles)

Figure 1: AgriMet Weather Station (BOR)

Figure 2: Location of Existing Flathead Area AgriMet Stations (Kjaersgaard & Allen, 2009)

Existing AgriMet Stations on or near the FIIP

Currently there are three AgriMet weather stations within the FIIP area (Figure 2):

1. St. Ignatius (SIGM) installed 4/1/91;
2. Round Butte (RDBM) installed 3/1/89; and
3. Creston (CRSM) installed 4/1/88.

In 2009 the University of Idaho included a review of the three existing AgriMet weather stations as part of their METRIC study conducted for the Mission Valley (Kjaersgaard and Allen 2009). Researchers voiced concerns about the Round Butte station proximity to trees and buildings (Figure 3) and documented lower pyranometer measurements during morning periods due to shading. Ultimately, the shading issue was deemed significant and researchers opted not to use the Round Butte station in their METRIC analysis; they instead relied on St. Ignatius and Creston stations.

Researchers also noted that the St. Ignatius station tended to measure more arid than reference conditions during periods with little or no precipitation in combination with high ET rates. This may be due to its proximity to the airport runway. This issue was not deemed significant enough to avoid using the station.

Figure 3: Round Butte Station and Tree Cover (photo by E. Mace, 2017)

AgriMet Station Cost and Funding

USBR informed us that a single AgriMet station typically costs slightly less than $10,000 for the initial equipment purchase and installation. Annual operating costs are approximately $1,000 per station. The USBR has verbally agreed to pay the initial equipment and installation fees of approximately $30,000 along with the annual operating costs of approximately $3,000 per year through the USBR Tribal Assistance Program.

In order to receive funding from the USBR Tribal Assistance Program the CSKT Tribal Council must to provide a letter supporting the installations and the USBR's funding of the equipment, initial installation and annual operation. Once a letter of support is provided by the Tribal Council, it will be provided to the USBR Tribal Assistance Program.

Land Ownership and Access

AgriMet stations need to be situated in open fields with relatively easy road access for operation and maintenance. The stations should not be within the immediate influence of direct irrigation. The stations need to be covered under an access agreement between the USBR and the landowner. The CITT suggests situating any new stations on CSKT trust lands as the USBR's access agreements with Tribes are less complicated than access agreements on other lands. The USBR has requested that once sites are determined, the Tribes provide an assessment of cultural and historic impact – a schematic of the station installations will be provided to better inform this effort.

The CITT is in the process of working with the CSKT Lands Department to identify the specific parcels and installation locations to situate the new stations. The general criteria:

1. CSKT trust land ownership
2. No shading or wind obstructions
3. Easily accessed by road
4. CSKT approved as owners and for cultural and social impacts
5. Within proximity to FIIP delivery area

CITT Recommendation #1: Number and Location of AgriMet Stations

AgriMet weather stations need to be situated across the FIIP to best represent most the different crop water irrigation requirement zones and the CITT. Using existing GIS weather data, anecdotal evidence, and comparisons of existing weather station information the CITT has determined an ideal weather station coverage for the area to include six stations in totality, three existing and three new installations:

New Station Recommendations	Existing Stations
Moiese (install in 2017)	St Ignatius (SIGM)
Little Bitterroot (install in 2017)	Round Butte (RDBM)
Jocko (install in 2019 see rec #2 below)	Creston (CRSM)

Station locations are mapped and parcel geocodes, parcel legal land descriptions, and site locations latitude/longitude are attached at the end of this document.

CITT Recommendation #2: Round Butte Station Relocation and Correction of Historic Data

The CITT recommends addressing the shading issue identified by Kjaersgaard and Allen in 2009. The CITT recommends moving the existing Round Butte weather station to a better location, but not before attempting to correct historic solar radiation data. The new Round Butte location map and parcel identification is attached to this document. The new location is near the existing site and devoid of the deleterious shading effects of the existing location. The CITT recommends installing one of the three new weather stations at this new location and running the new station concurrently with the existing Round Butte station, thereby allowing for a correlation correction factor to be developed by comparing the simultaneously collected solar radiation information. If successful, the correction factor can be used to improve the quality of the historic data collected at the existing Round Butte site, thereby allowing for improved confidence in its future use. This can likely be achieved in a two-year period at the end of which, the existing Round Butte station can be moved to the Jocko to provide weather measurements for that area. If desired, the CITT offers its assistance with the data correlation and development of a correction factor.

Timeline and Next Steps

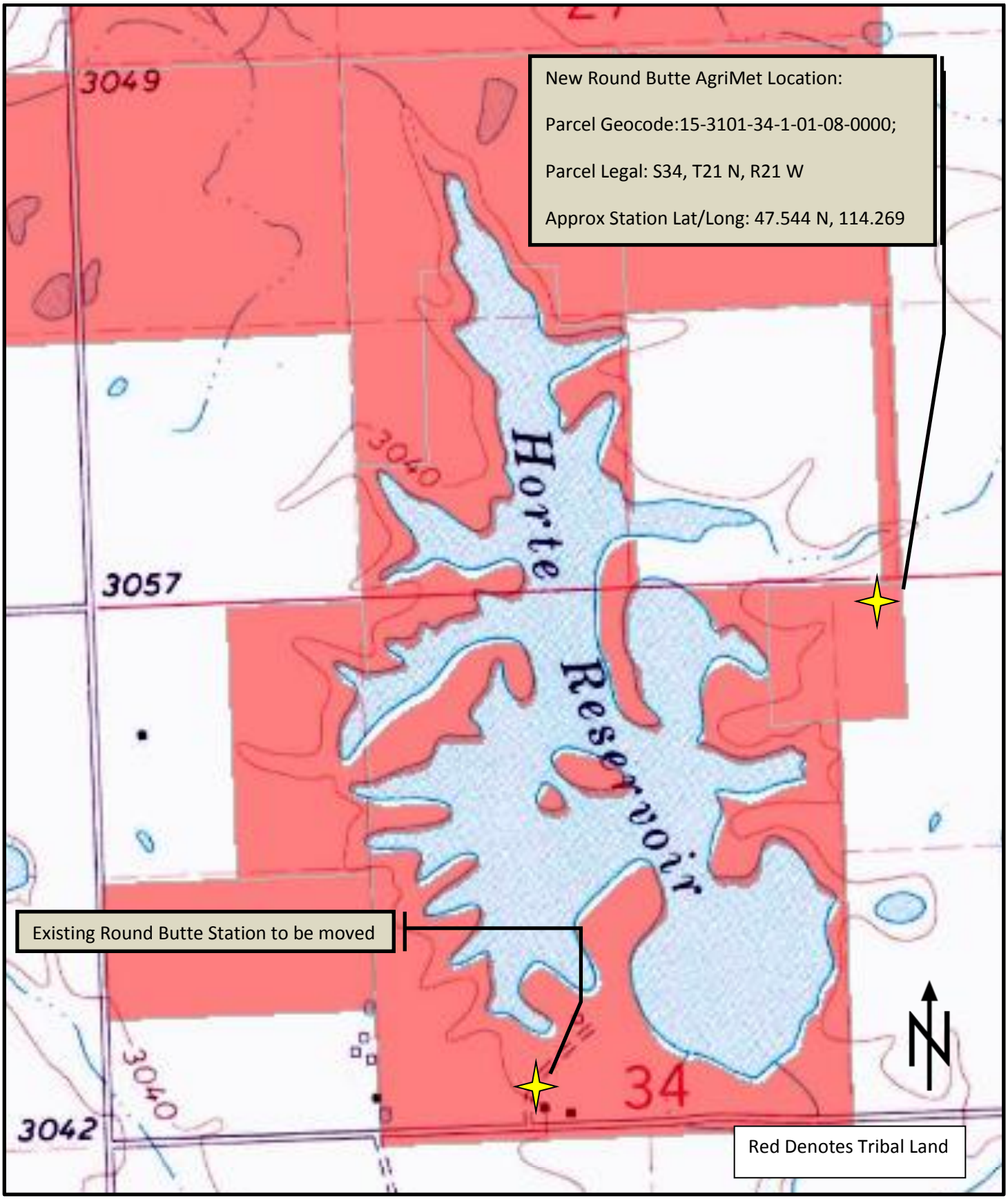
June 21 CITT meeting	Formalize recommendations through CITT vote
June	Receive Tribal support letter for AgriMet recommendation
June	Formalize access agreements
July-August	Install equipment

References

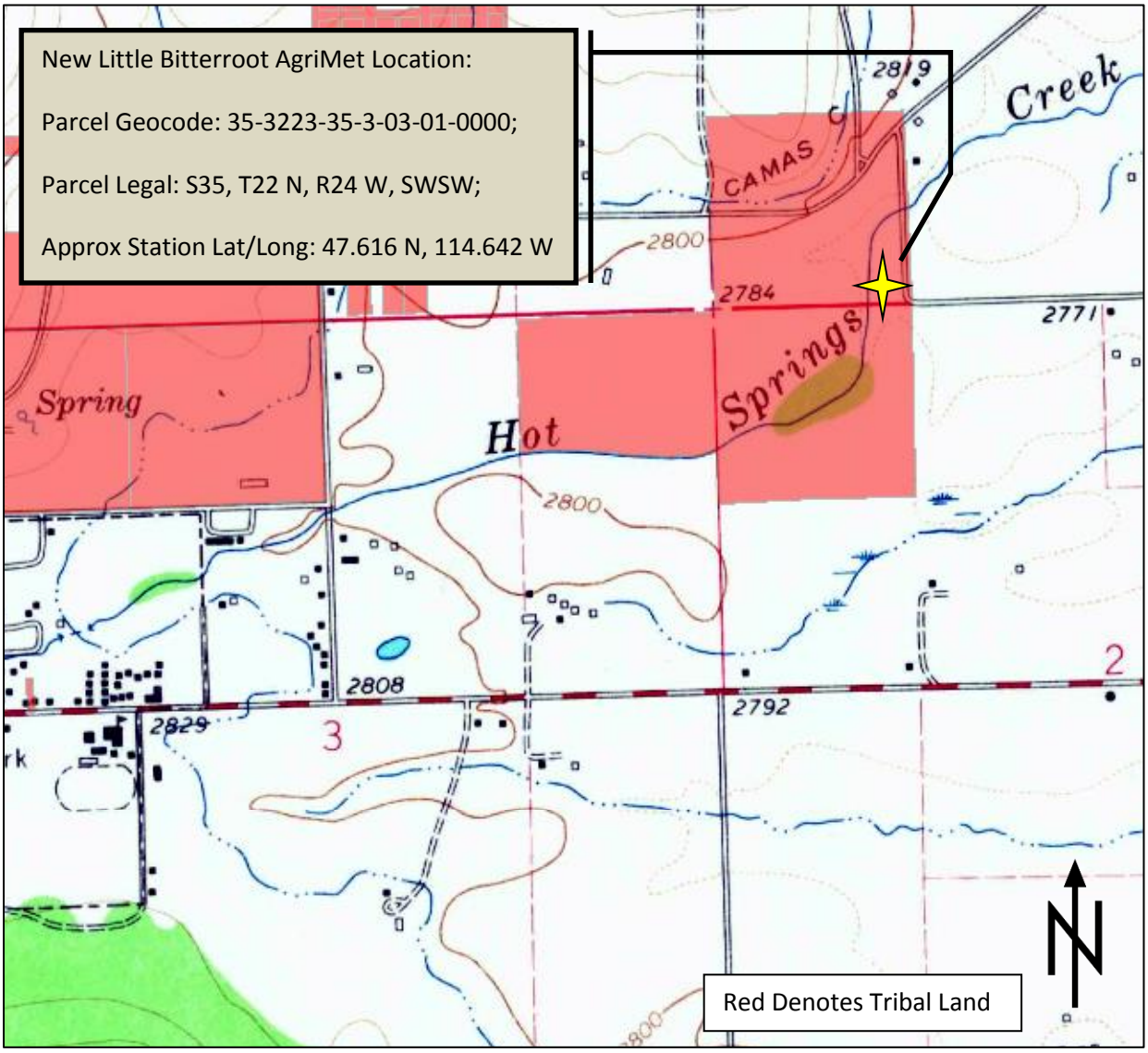
2016. Website Information: Reclamation / Pacific Northwest Region / AgriMet / General Information. https://www.usbr.gov/pn/agrimet/general.html

Kjaersgaard, Jeppe and Allen, Richard. 2009. Field-scale evapotranspiration from the Mission Valley using METRIC; report submitted to the Montana Department of Natural Resources and Conservation. Kimberly R & E Center, University of Idaho.

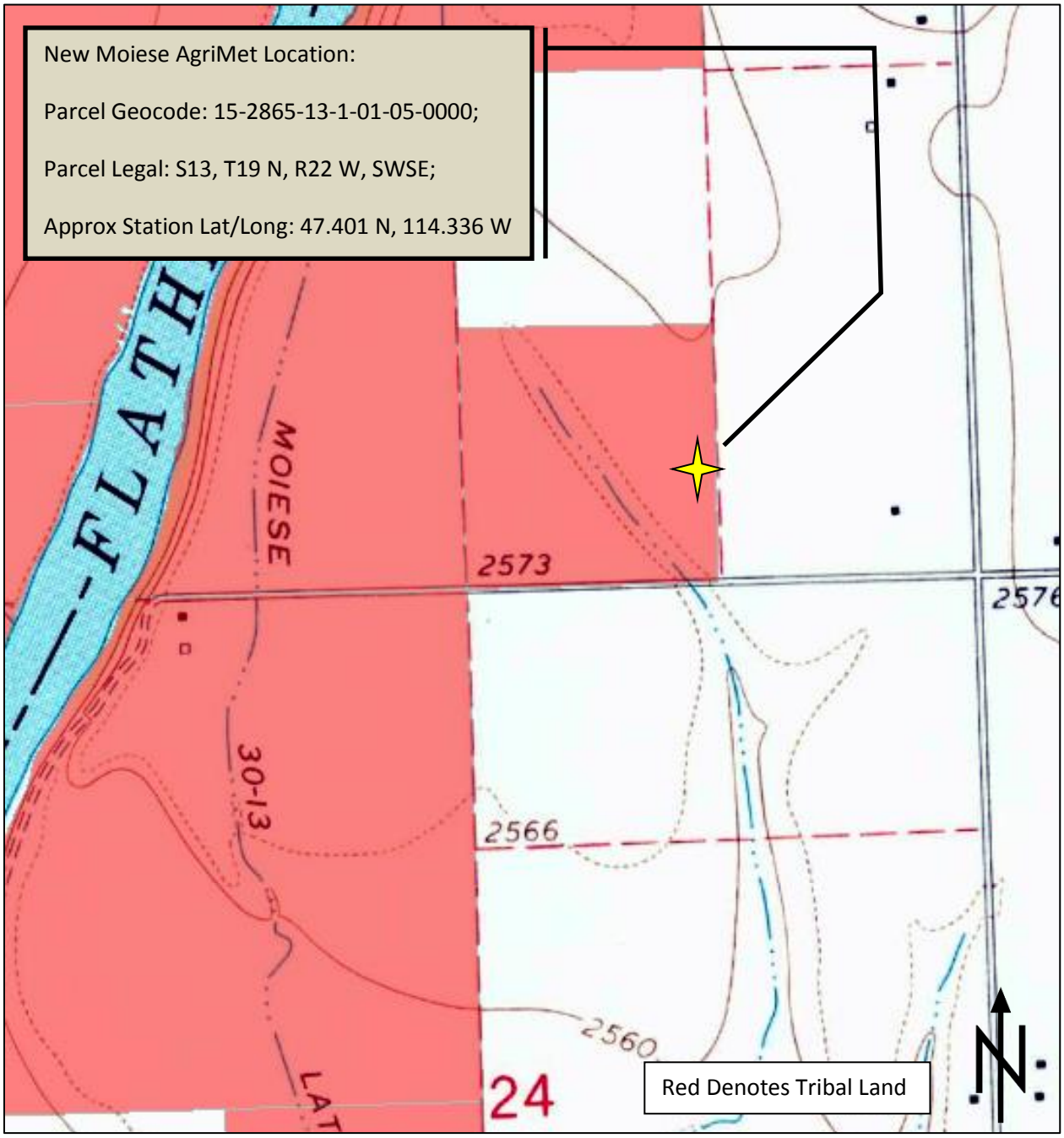
Round Butte AgriMet Station: Relocation of Existing



Little Bitteroot AgriMet Station: New Station



Moiese AgriMet Station: New Station



Jocko AgriMet Station: New Station