

# DIGITAL MAPPING TECHNIQUES 2023

The following was presented at DMT'23

May 21 - 24, 2023

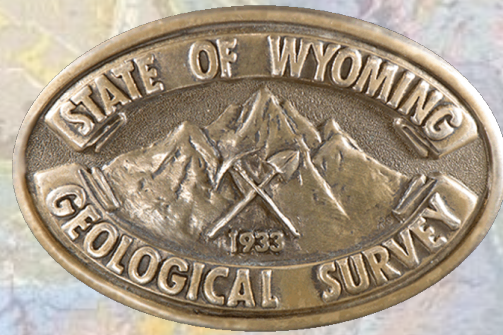
The contents of this document are provisional

See Presentations and Proceedings  
from the DMT Meetings (1997-2023)

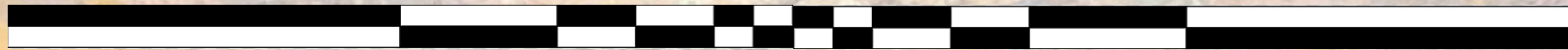
<http://ngmdb.usgs.gov/info/dmt/>

The WSGS developed a peer review process for its map publications. The review process is scheduled months in advance and follows a shared review checklist alongside editorial standards. The review process includes geologic, cartographic, and digital components, and takes 2—3 months to complete. The WSGS review checklist and cartographic standards are available upon request.





Wyoming State Geological Survey  
**“The WSGS peer review process—  
geologic, cartographic, and digital”**



JAMES AMATO  
*Digital Mapping Techniques 2023*



# WSGS Map Publication Series

## Open File Report (OFR)

- Preliminary map, research is still ongoing
- Publication that can stand either temporarily or permanently
- Information that is timely and would fill a public need
- Information that is not sufficiently refined to warrant publication in another series at this time
- Needs release for general critique and comment before being finalized for printing/publishing

## Map Series (MS)

- Final mapping of any scale, including finalized version of an Open File Report preliminary map
- Requires external geologic review
- One or more cross sections, as appropriate

## Interactive/Online Maps (IMAP)—Digital Data Series?

- Definitions and review guidelines are currently a *work in progress*

# WSGS Map Publication Frequency

## 2023/2024

- 1:100,000—Bedrock compilation map of Rawlins (STATEMAP – Map Series)
- 1:100,000—Bedrock compilation map of Red Desert (STATEMAP – Open File Report)

## 2022/2023

- 1:100,000—Bedrock compilation map of Firehole Canyon (STATEMAP – Open File Report) \*
- 1:100,000—Surficial map West Half of Ramshorn (STATEMAP – Open File Report)
- 1:100,000—Surficial map Carter Mountain (WSGS funded – Open File Report) \*
- 1:100,000—Surficial map Thermopolis (WSGS funded – Open File Report) \*
- 1:100,000—Surficial map Riverton(WSGS funded – Open File Report) \*

## 2021/2022

- 1:24,000—Bedrock map of King Mountain (Earth MRI – Map Series) \*
- 1:24,000—Bedrock map of Ragged Top Mountain (Earth MRI – Map Series) \*
- 1:24,000—Bedrock map of Phantom Lake (STATEMAP – Map Series)
- 1:24,000—Bedrock map Oil Mountain (STATEMAP – Open File Report)
- 1:100,000—Surficial map East Half of Jackson Lake (STATEMAP – Open File Report)
- 1:500,000—Precambrian Basement Map of Wyoming (NGGDPP – Open File Report) \*

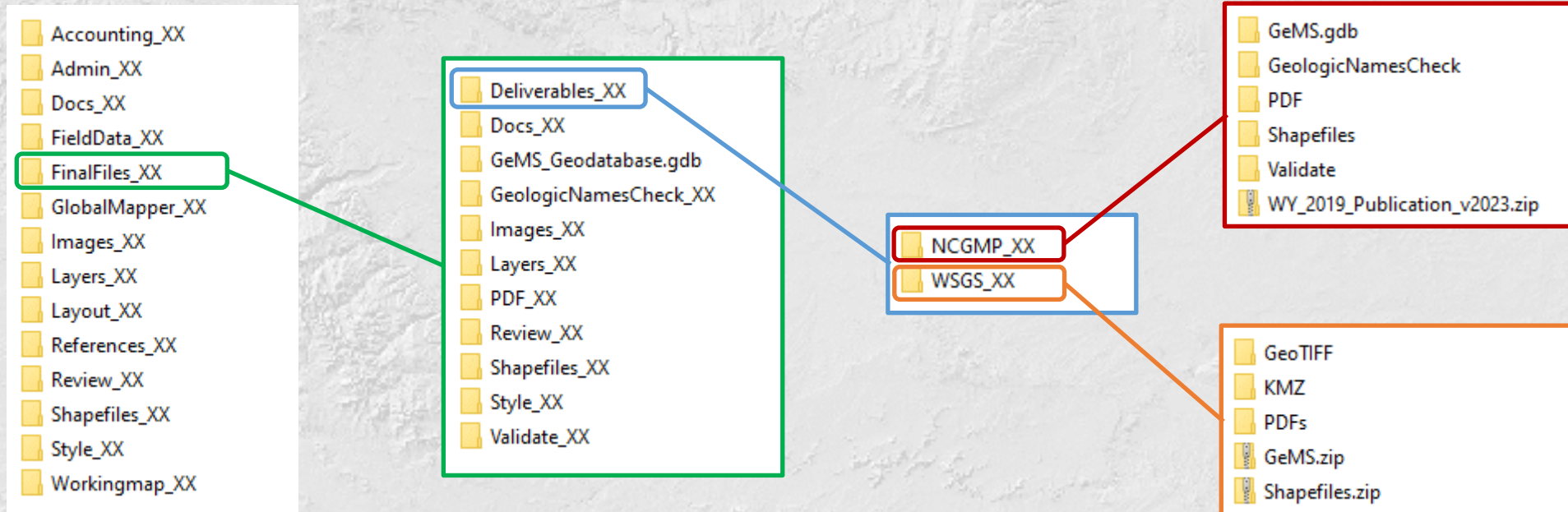
## 2020/2021

- 1:24,000—Bedrock map of Guide Rock (WSGS funded – Map Series) \*
- 1:24,000—Bedrock map of Poe Mountain (WSGS funded – Map Series) \*
- 1:24,000—Bedrock map of Goat Mountain (STATEMAP – Open File Report)
- 1:24,000—Bedrock map of Richards Gap (STATEMAP – Open File Report)
- 1:100,000—Bedrock compilation map of Rock River (STATEMAP – Open File Report)
- 1:100,000—Surficial map West Half of Jackson Lake (STATEMAP – Open File Report)

\* Denotes multi-year project



# Project Folder File Structure



# Field Season: typically 3 to 4 months

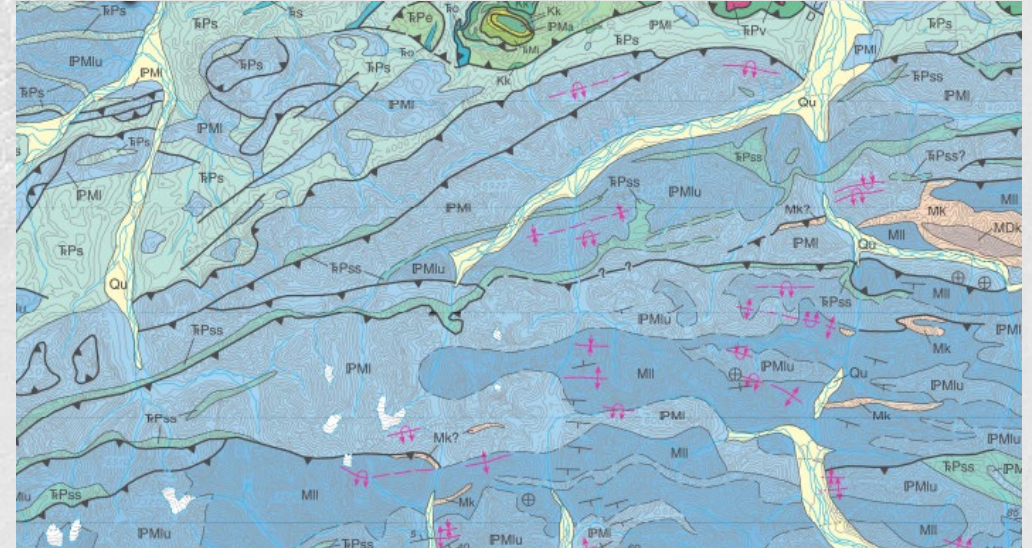
- Normally STATEMAP project starts June 1 when funding is approved; the first month involves literature review, data structure, photo interpretation, and preliminary line work. The field season usually begins around July 1; we tend to have a late spring, and snow in the mountains doesn't usually melt until early-mid July.
- We usually wrap up field work in late September/early October; hunting season starts, and the first snowfall usually hits in October.
- Based on proximity of the field area, field visits can range from a day to two weeks. We try to space a week in between longer trips to process notes, data, and samples.
- Mappers use their choice of field collection methods, varying from hardcopy maps and GPS units to tablets and SDE databases. Often field conditions and other variables require a mixed approach to mapping.





# Layout: typically 4-5 months

- Layout begins as the field season wraps up, normally starting in September/October and wrapping up in February/March. Mappers are responsible for 100% layout, contractors assist.
- We use GeMS and follow FDGC symbology when possible. For cartographic reference and guidance we provide:
  - GeMS tutorial videos
  - Map creation/layout SOP's
  - ArcGIS templates and customized GeMS geodatabases
  - 24k/100k WSGS map standards
- All cartography/layout has been done in ArcMap in the past (**in the process of migrating to ArcPro**)
  - Basemaps are created using USGS NAD27 topos with a 10m DEM derived Hillshades
  - Final mashups are created in Global Mapper (Basemaps + MapUnitPolys)
  - DMU and Disclaimers/Notices are inserted Word documents
  - CMU graphic's are created in Arc, but not transcribed into GeMS
  - Cross sections are created using the ArcGIS CrossView extension and transcribed into GeMS
  - We complete cross sections for 24k maps when applicable







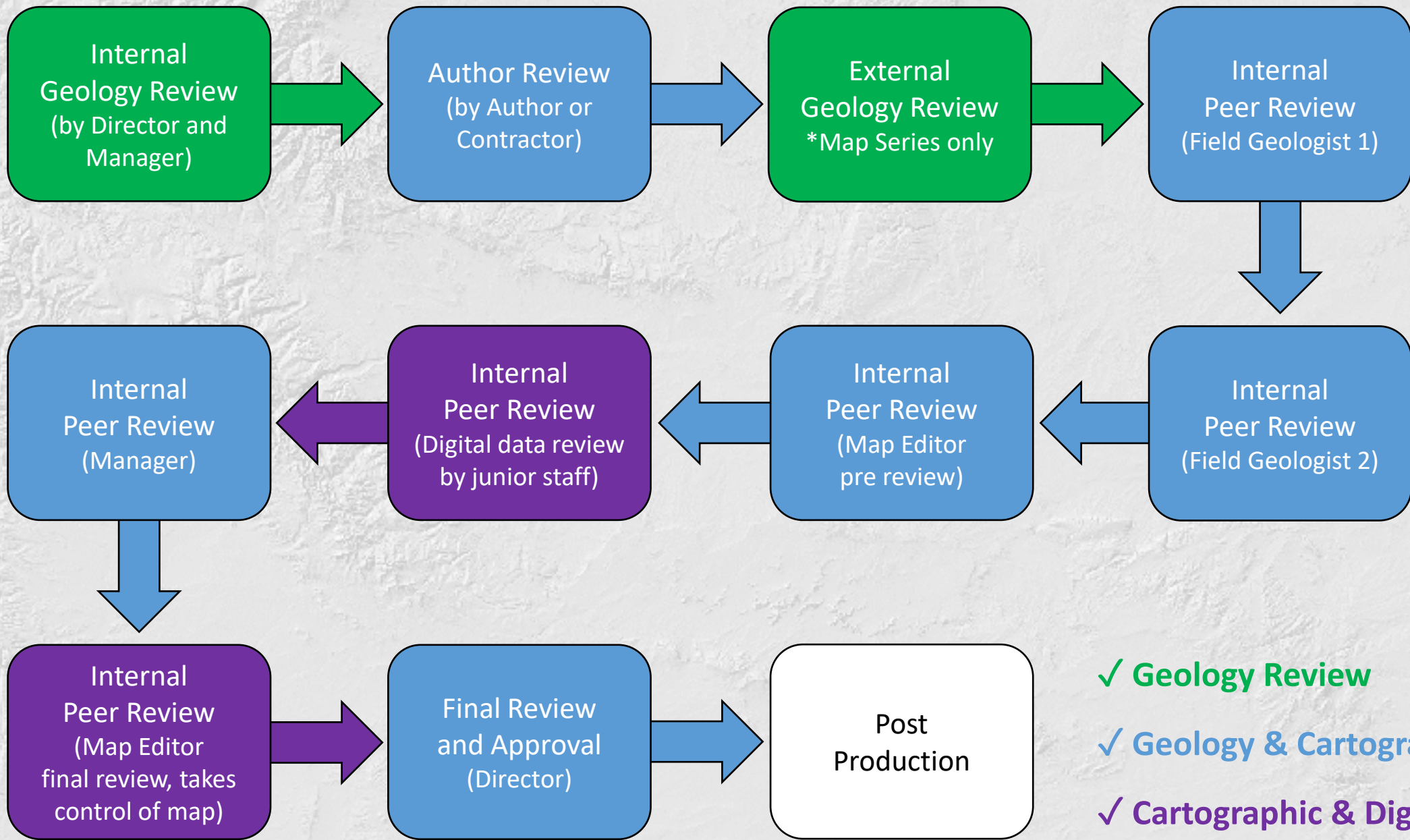


# Review: typically 2-3 months

- Official reviews are scheduled to start in March and wrap up May 31. By then the authors have already reviewed the geology and data to make sure it's ready to move forward. The review process is scheduled in fall (via a shared Google calendar) to allow team members to set their deadlines and keep the project(s) on track. Scheduling can be challenging. The number of maps in review at a given time can make scheduling difficult. Timelines contain built-in wiggle room to accommodate for unforeseen issues.
- Each map is peer reviewed 9 times for OFR's, and 10 times for MS's. Digital data is reviewed twice throughout the process. All reviews are completed by other mappers. This helps keep everyone up-to-date on common issues, concerns, and revisions. The geologist learns to become a better cartographer through this process. The review schedule is set up so that if your not working on your edits you're reviewing someone else's map and vice versa.
- Map Editor reviews the map twice; once in the middle (pre) and once at the end (final). The Map Editor takes full control of the map during the last review and makes any final edits, delivers map to the Director for final approval, and prepares deliverables for the public and feds.







✓ **Geology Review**

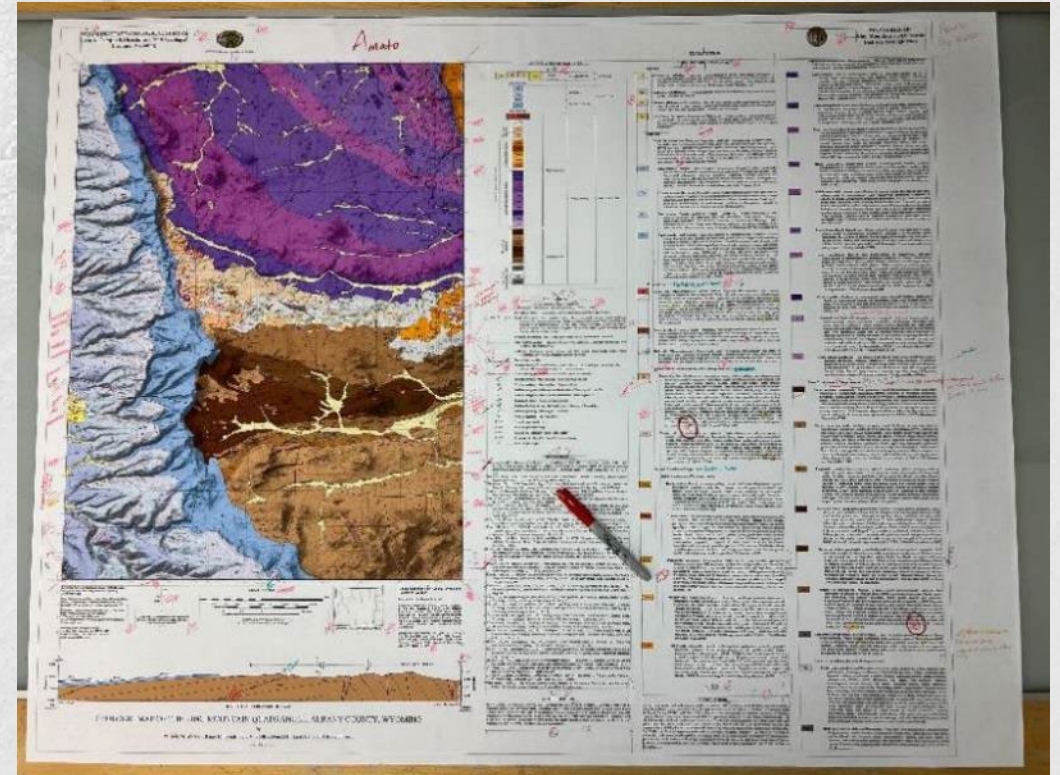
✓ **Geology & Cartographic Review**

✓ **Cartographic & Digital Review**



# Review Process:

- We use a shared Excel spreadsheet as a Review Checklist and save it in the Review folder of the Project folder on the network. Every reviewer is provided an up-to-date geodatabase, .mxd/aprx, .pdf, and printed map.
- We schedule (2) 8-hour days to complete a review, followed by (3) 8-hour days for the author to complete the edits in time for the next review. This is ample amount of time for the reviewer and author to complete their tasks. It takes me (the Map Editor) a minimum of (1) 8-hour day to use our checklist and thoroughly review the map (usually I'll spend two full days to review). We schedule 3 weeks for external geology reviews.
- Most reviews are completed by looking at a printed map and annotating with edits in red pen. All edits are digitally transcribed and compiled on each reviewers individual tab of the shared spreadsheet. This allows a place for the author to accept/rebut edits, in addition for future reviewers and the map editor to look at past edit requests.





# Review Checklist

One shared Excel checklist that lives in the Review folder of the Project folder

<b>Map Publication Review Checklist</b>												
<i>(Keep this form in the Review folder)</i>												
					Map Publication: <b>King Mountain 24k-Bedrock (Map Series)</b>							
					Author: Patty Webber, Ranie Lynds							
					Reviewer 1: James Mauch							
					Reviewer 2: Derek Lichtner							
• Reference the 24k and 100k map standards as needed					Digital Data Review: David Lucke							
• Be available to work through the entire review process efficiently (April and May)					Editor: James Amato							
• Reviews are to be competed in order according to schedule (no skipping/simultaneous reviews)					Supervisor: Ranie Lynds / Seth Wittke							
• Reviewer substitutions need to be approved by your manager and the map editor					External: Don Lindsley, Ron Frost, Carol Frost, Alan Ver Ploeg							
• No partial reviews (get everything completed before submitting)												
• Author makes edits as needed between each review check												
• Author saves revised copies (.mxd .gdb .pdf) in review folder after each round of edits												
• Do not ignore edit requests (complete or note why uncompleted)												
• Geology needs to be reviewed by the Director prior to Reviewer 1 submission												
• Do not submit map and geodatabase for Editor Final Review until everything is complete												
• Failure to meet scheduled deadlines (by end of work day) will be noted in PMI												
		<b>Scheduled:</b>		3/1/2022	3/28/2022	4/4/2022	4/11/2022	4/18/2022	4/25/2022	5/2/2022	5/9/2022	
		<b>Date In:</b>		3/25/2022	3/3/2022	3/28/2022	4/4/2022	4/8/2022	4/19/2022	4/25/2022	6/8/2022	6/17/2022
<i>Item to be checked ( ✓ ) upon completion or note (#) provided to author of edit request on Review tabs</i>		Author	External	Reviewer 1	Reviewer 2	Editor (Pre)	Digital Data	Supervisor	Editor (Final)	Director		

# Review Checklist

	Scheduled:		3/1/2022	3/28/2022	4/4/2022	4/11/2022	4/18/2022	4/25/2022	5/2/2022	5/9/2022
	Date In:	3/25/2022	3/3/2022	3/28/2022	4/4/2022	4/8/2022	4/19/2022	4/25/2022	6/8/2022	6/17/2022
	Item to be checked ( ✓ ) upon completion or note (#) provided to author of edit request on Review tabs	Author	External	Reviewer 1	Reviewer 2	Editor (Pre)	Digital Data	Supervisor	Editor (Final)	Director
Margin Information	Check map position and margins; neatlines	✓		✓	✓	1	✓	✓	1	
	Check centering & position of components	1		✓	✓	2	✓	1	2	
	Fonts standardized (typestyle & size) throughout (see Standards Map)	✓		✓	✓	3	✓	✓	✓	
	Title, preliminary?, correct quad, counties in order	✓		✓	✓	✓	✓	✓	✓	
	Authors/compiler, in correct order	✓		✓	✓	✓	✓	✓	✓	
	Publication date (release date) is correct	✓		✓	✓	✓	✓	✓	✓	
	North arrow; magnetic declination is current/correct	✓		✓	✓	4	✓	✓	✓	
	Bar scale(s) and text scale, agrees with map	✓		✓	✓	✓	✓	✓	✓	
	Contour interval for topographic map (from topo)	✓		✓	✓	✓	✓	✓	✓	
	Base map source, name, date (from topo)	✓		✓	✓	✓	✓	✓	✓	
	DEM/Hillshade source and publish year are correct	✓		✓	✓	✓	✓	✓	✓	
	Projection and UTM/SPCS grid tics	✓		✓	✓	✓	✓	✓	✓	
	Cartographer(s); Editor; Acknowledgements	✓		✓	✓	✓	✓	2	✓	
	Suggested citation is included and correct	✓		✓	✓	5	✓	✓	12	
	Quad location map correct, titled	✓		✓	✓	✓	✓	✓	✓	
	Index map to series (where applicable-100k)	N/A		N/A	N/A	N/A	N/A	N/A	N/A	
	Index to sources of geologic mapping; title (100k)	N/A		N/A	N/A	N/A	N/A	N/A	N/A	
	Survey ID; State Geologist; Laramie, WY	✓		✓	✓	✓	✓	✓	✓	
	State and WSGS logos, top aligned, sizes on template	✓		✓	✓	2a / 2b	✓	✓	3	
	Cooperative agencies; Award no.; Other logos	✓		✓	✓	✓	✓	✓	✓	
	Series designator- (MAP SERIES 2022- )	✓		✓	✓	✓	✓	✓	✓	
	Map name, scale, bedrock or surficial in upper right	✓		✓	1	✓	✓	✓	✓	
Notice for Open File Reports/WSGS Disclaimers/Notice to Users	✓		✓	✓	✓	✓	3	✓		
Bordering quads labeled (in layout)	✓		✓	✓	6	✓	4	✓		
Mashup legible: Topo and Hillshade are visually balanced	✓		✓	2	✓	✓	✓	✓		



# Review Checklist

Explanation	Type/font size, text/header alignment/indents all consistent	✓	✓	✓	7	✓	5	✓	
	Units of measure are correctly converted and show correct # of sig figs	✓	1	3	8	✓	✓	✓	
	Point features, sizes/colors agree with map	✓	✓	✓	9	✓	6,7	✓	
	Line features, sizes/colors agree with map	2	2	4	10	✓	8	4	
	Polygon features, outlines/colors agree with map	✓	✓	5	11	✓	✓	✓	
	Labels agree with map/correlation chart/descriptions	✓	✓	✓	12	✓	✓	5	
	Colors agree with map/correlation chart/descriptions	✓	3	✓	✓	✓	9,10,11	✓	
	Colors/sizes of other symbols same as in map	✓	✓	✓	13	✓	✓	✓	
	Spelling/ typos/ names	✓	4	6	✓	✓	✓	✓	
	Wyo stratigraphic nomenclature and symbology consistent with surrounding maps	✓	✓	✓	✓	✓	✓	✓	
	Unit descriptions in correct order and coincide with correlation chart	✓	✓	✓	14	✓	✓	✓	
	Unit descriptions include m (ft) measurements where needed and are correct	✓	5	7	15	✓	N/A	N/A	
	Correlation chart ages and subages correct, DMU headers included	✓	6	✓	✓	✓	✓	✓	
References match ref list, are in order; in correct WSGS format; full justified	✓	✓	8	16	✓	N/A	✓		
Digital Data Review	ArcMap.mxd: Relative path names stored correctly to the Final Files folder					✓		✓	
	ArcMap.mxd: Data frame reference scale set 24k or 100k					✓		✓	
	ArcMap.mxd: Inserted images/docs are saved to map and included in Final Files folder					✓		✓	
	ArcMap.mxd: Layer property symbology cleaned up (no 0's)					1 - 6		6	
	ArcMap.mxd: MapUnitPolys & clipped topo included but turned off					✓		✓	
	Attributes: No values in Notes (unless beneficial to end user)					✓		7	
	Attributes: LocationConfidence correspond correctly with Map Symbol definitions					7		8	
	Attributes: Concealed values corresponds correctly to symbology					✓		✓	
	Attributes: Any .gdb data excluded from the map PDF (def queries) has been reviewed					✓		✓	
	Attributes: All unplaced annotation removed					✓		✓	
	Non spatial tables: All elements are appropriately cited with a datasource					✓		✓	
	Non spatial tables: Content is current and correct (DMU & References)					10		✓	
	Non spatial tables: DMU HeirarchyKey and ParagraphStyle is correct					✓		9	
Deliverables: Check GeMS validation (no errors, warnings) - Level 3 compliant					14		10		
Deliverables: All elements in .gdb have correct metadata (& thumbnails)					11		11		
Deliverables: MapUnitOverlayPolys used cartograohicly to export PDF excluded					12		✓		
Deliverables: Style.file works correctly on GeMS .gdb and shapefiles					13		✓		



# Review Checklist

Cross section	Verify orientation of x-sec line matches corners and title	✓	✓	✓	✓	✓	✓	✓	✓
	Topographic profile; major features on x-sec	✓	7	9	✓	✓	12	✓	
	Structural features on map match x-sec	3	8, 9	10, 11	✓	✓	13a, 13b	✓	
	Map lines correctly intersect profile	✓	✓	✓	✓	✓	✓	✓	
	Vertical exaggeration correct/reasonable	✓	✓	✓	✓	✓	✓	✓	
	Faults/contacts match map symbols; hw/fw match	✓	✓	✓	✓	✓	✓	✓	
	Labels for faults/map units consistent w/all	✓	10	✓	17	✓	✓	✓	
	Multiple x-sec consistent, w/units/faults	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Unit thickness is consistent and agrees with DMU descriptions	4	✓	✓	✓	✓	✓	✓	
	Vert. & horiz. scales shown, end pts labeled	✓	✓	12	✓	✓	14	✓	
Geology / Cartography	Colors/units/symbols agree w/explanation	✓	✓	✓	8,9	15	✓		
	Symbols consistent with common usage	✓	✓	13	18	✓	✓	✓	
	Map unit annotation (anno) is in (or near) the center of each polygon	✓	11	14	✓	✓	✓	✓	
	Leaders are as short as possible and do not cross unnecessary lines	✓	✓	✓	19	✓	✓	✓	
	Inclination values are placed at the point of strike/dip and foliation symbols	✓	✓	15	20	✓	✓	✓	
	Unit/Formations conform with regional nomenclature	✓	✓	✓	21	✓	✓	✓	
	Strike and dip are located correctly and logically	✓	✓	16	✓	✓	✓	✓	
	Anticlines and synclines are located correctly and agree with strike/dip measurements	✓	12	17	22	✓	✓	✓	
	Folds are symbolized correctly	✓	✓	✓	✓	✓	✓	✓	
	Follow rule of v's	✓	✓	18	✓	✓	✓	✓	
	Faults are symbolized correctly (decorations on correct side of fault, right hand rule)	✓	13	✓	23	✓	✓	✓	
	Fault/line decorations are appropriately spaced	✓	✓	✓	24	✓	✓	✓	
	Faults under Quaternary units (and Tertiary if appropriate) are dotted/concealed	✓	14	19	25	✓	✓	✓	
	Question marks (?) placed at the end of faults that terminate in Quaternary units	N/A	15	✓	23, 9	✓	✓	✓	
	Contacts are symbolized correctly	✓	16	✓	✓	✓	✓	✓	
	All units/symbols in legend are on map, and vice versa	✓	17	✓	✓	✓	✓	✓	
	No strike/dip or foliation measurements in Quaternary units	✓	✓	✓	✓	✓	✓	✓	
	Structure is defensible	✓	✓	20	✓	✓	✓	✓	
	Date Out:	Date Out:	Date Out:	Date Out:	Date Out:	Date Out:	Date Out:	Date Out:	Date Out:
	3/25/2022		3/29/2022	4/5/2022	4/12/2022	4/20/2022	4/26/2022	6/15/2022	6/22/2022



# Review Checklist

REVIEWER	DESCRIPTION	AUTHOR	NOTES
Note	Description	Completed	Notes
1	Minor: should "scale" be capitalized? It hasn't in the past. Hyphenated words should be capitalized in titles, but this isn't actually the pub title. But "Bedrock Geologic Map" is capitalized, which makes me wonder if this entire upper-right corner should be title case	✓	keep lowercase, as determined in an email from Amato and Christina
2	Hillshade clashes with the darker units colors, especially the browns. Maybe for future years we should consider a more subtle "multidirectional" hillshade instead of our current Global Mapper SOP	no action	we could try this if someone knows how to do it differently...
3	I just heard we can go all-metric, so yay! Problem solved	✓	
4	Yp, Ym, and Ygd dikes are still a major visual issue. I can't tell them apart. A few ideas on this: A) label a few key lines; I've seen this done for sandstone marker beds, e.g. Roehler Firehole Canyon area maps. B) consider drastically different colors. C) page A-1-5 in the FGDC pdf shows 6 different options for dike symbology--consider making these each different symbols, not just different colors. D) I also think the dike lines should be part of the hillshade mashup. Right now they appear to be floating above the hillshade shadows, and look more like some weird generic fold map symbol as opposed to part of the geology	✓	will try the mashup with the dikes and see what happens, also changed symbology for Ym to make it more obvious
5	Ranie mentioned there are still some color discrepancies b/w the DMU and map for the Chugwater units. I personally can't tell...	✓	
6	I made some DMU style and grammar suggestions in the doc "KM_DMU_DL_20220404.docx"	✓	Replied to comments in DMU, showed changes that were made with track changes
7	See #3--metric!	✓	
8	Made a few minor comma suggestions in References on paper copy	✓	
9	I second Reviewer 1's #7: consider labelling Roger Canyon on the cross section. I see your author response notes, but here are my thoughts: it is not only a key topographic feature labelled on the topo map but also the name of the road that provides access to most of the quad, and geographic feature well-known by locals. Above the left end of the cross section is also possibly the least cluttered part of the map layout--I see minimal drawbacks to labelling this	no action	Labeling this opens up a can of worms in terms of the road, or the canyon, or whatever. I am going to not label it for the moment.
10	Sherman granite "branch" at east end of cross section--I understand why it is drawn there, considering the Ragged Top map just to the east, but is there any evidence...a dike from it that reaches the surface, or...? In just my quick glance at the map, it sticks out as strange	no action	No evidence. Just the fate of a hard-rock x-section. Evidence is just off the map - abundant dikes that rapidly increase in number to the south and east. It shows recognition of the regional picture, not just the quad
11	Does the different spacing between foliation traces on either side of the fold in the cross section convey anything? I know these aren't sed units, so thickness conservation isn't an issue, but the varied spacing looks weird, and if it doesn't convey any info, I suggest making the spacing more uniform	✓	Spacing shifted periodically throughout various iterations of the cross section. The orientations are based on surface measurements, but line placement can be adjusted in accordance with measurements to show the structure more aesthetically
12	My original comment was to make one of the cross section axes metric, but now because of #3, you can make both metric!	✓	metric added to right side
13	I'm used to seeing "U/D" fault labels rotated perpendicular to the fault trace. See WSGS Fort Steele map or USGS Point of Rocks SE. Are we doing page-up orientation now...?	✓	Yes, according to Amato we are doing page-up orientation
14	A few minor annotation adjustment suggested on paper copy, in particular Qof near western boundary	✓	
15	A few orientation labels are too close to the symbol and overlap/touch. Noted on paper copy of map	✓	
16	A couple weird orientation measurements--just want to double check that those are indeed the correct measurements, and they weren't plotted wrong. Noted on paper copy, NW of sec. 4 in northwestern quad	✓	nice catch!
17	Instead of the cluttered anticline in the southwestern corner of the quad, what about labelling the syncline implied to the northeast of it? There is more room for the symbology. And the southwestern limb of the anticline isn't on the quad, so labelling it as an anticline is somewhat awkward	✓	Agree on the awkwardness. However, this is a major named anticline and this map (unfortunately!) just clips it. The map to the south does not add the syncline. I think we should leave it. I'd love to label the anticline but the leader would need to cross several map units which would make it even more awkward. Agree with leaving the anticline; would be fine adding the syncline too, but not in exchange for the anticline. -- Anticline has been extended through measurable trace that continues to southeast
18	I noted a few very minor linework adjustments in the Casper where the contact doesn't interact w/ the topography like I would expect	✓	Linework matches with imagery. I think we need to go with that. Did fix one of the three, highlighted on map



# Questions?



--

**James Amato**

**Wyoming Geological Survey**

Map Editor & Geospatial Technical Principal

[james.amato@wyo.gov](mailto:james.amato@wyo.gov)

307-766-2286 ext.250