[DAM Name]

5-Year Dam Evaluation

*Engineer’s REPORT*

Inventory No. [MT-0000]

[County], Montana



*January 1, 2023*

**Dam Owner**

Dam Owner: [Name]

Dam Owner Representative: [Name]

**Engineer**

Engineer of Record: [Name]

Agency/Organization: [Name]

NOTE TO USER:

*Montana Department of Natural Resources & Conservation Dam Safety Program (Montana Dam Safety) has provided this template to facilitate completion of engineer responsibilities with regard to the Five-Year Dam Evaluation Report. This template should be used in accordance with Section 4.0 of Montana Dam Safety’s “Guidelines for Five-Year Dam Evaluations”.*

*Note that this is a generic template, and unique appurtenances or site conditions at a specific dam may not be referenced herein. The Engineer is responsible to identify all features that should be evaluated and documented in the Evaluation Report. The template is flexible and can be edited and tailored to a specific dam. Additional report sections should be added as needed to address all appurtenant structures.*

**5-YEAR DAM EVALUATION –** [Dam Name]

*Engineer’s REPORT*

Inventory No. [MT-0000]

[County], Montana

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Appendix A – Pertinent Plans & Background Information

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Appendix C – Instrumentation Supporting Documentation

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1. DAM BACKGROUND & HISTORY (*Required for all dams.*)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Dam Information*** | | | | | |
| Dam Name: | [Dam Name] | Inventory No: | | | [MT-0000] |
| County: | [County] | Hazard Class: | | | *High* |
| ***Dam Owner Information*** | | | | | |
| Owner: | [Name] | | Owner Contact: | [Name] | |
| Address: |  | | Phone: |  | |
|  | Email: |  | |
| ***Engineer Information*** | | | | | |
| Agency: | [Name] | Engineer of Record: | | | [Name] |
| Address: |  | Phone: | | |  |
|  | Email: | | |  |

* 1. Dam Records & Available Documentation

|  |  |
| --- | --- |
| Indicate which of the following were obtained and reviewed: | |
| Owners Questionnaire  Previous Evaluation Report  Design Records  As-Built Drawings  Drawings for Modification(s)  Other Historical Inspection Reports (list below)  Operational & Maintenance Records  Construction Records  Other (list below) | Flood Records  Pool Level Records  Piezometric Levels  Seepage Records  Hydrologic & Hydraulic Analysis  Embankment Stability Analysis  Structural Stability Analysis  Outlet Works Analysis  Include pertinent drawings in Attachment A. |
|  | |

* 1. Dam Data

|  |
| --- |
| Provide a brief description of the dam and its appurtenances: |
|  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | | **Value** | | **Source** |
| **General Data** | | | | |
| Dam Type | |  |  |
| Dam Purpose | |  |  |
| Drainage Area | |  |  |
| Stream(s) | |  |  |
| Year Built | |  |  |
| Designer | |  |  |
| **Dam Properties** | | | | |
| Structural Height | |  | |  |
| Hydraulic Height | |  | |  |
| Upstream Slope | |  | |  |
| Downstream Slope | |  | |  |
| Dam Crest Width | |  | |  |
| Dam Crest Length | |  | |  |
| **Key Elevations (feet)** | | | | |
| Vertical Datum and Conversions | | *Unless otherwise noted, all elevations within this report are referenced to [datum name]. This datum is equivalent to the NAVD88 datum +/- XX feet.* | | |
| Top of Dam | |  | |  |
| Auxiliary Spillway Crest | |  | |  |
| Principal Spillway Crest | |  | |  |
| Normal Pool Level | |  | |  |
| Sediment Storage Level | |  | |  |
| Outlet Conduit Upstream Invert | |  | |  |
| Outlet Conduit Downstream Invert | |  | |  |
| **Storage Capacities (acre-feet)** | | | | |
| Top of Dam | |  | |  |
| Auxiliary Spillway Crest | |  | |  |
| Normal Pool | |  | |  |
| Sediment Storage | |  | |  |
| **Pool Surface Areas (acres)** | | | | |
| Top of Dam | |  | |  |
| Auxiliary Spillway Crest | |  | |  |
| Normal Pool | |  | |  |
| Sediment Storage | |  | |  |
| **Other Features** | | | | |
| Principal Spillway Type | |  | |  |
| Principal Spillway Weir Length | |  | |  |
| Outlet Conduit Diameter | |  | |  |
| Outlet Conduit Length | |  | |  |
| Auxiliary Spillway Type | |  | |  |
| Auxiliary Spillway Weir Length | |  | |  |
| Other Key Data | |  | | *(Insert Additional Rows as Needed)* |
|  | | | | |

* 1. Dam History

|  |
| --- |
| Describe the flood of record that resulted in peak outflow and maximum reservoir elevation observed at the dam. Include an estimate of the peak outflow and maximum reservoir elevation: |
|  |
| Describe the event(s) that resulted in peak outflow and maximum reservoir elevation within the past five year period (if different from the flood of record). Include an estimate of the peak outflow and maximum reservoir elevation: |
|  |

|  |  |
| --- | --- |
| **Date** | **Description of Major Incidents/Modifications** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

* 1. Other Items of Note

|  |
| --- |
| Describe any other items of note pertaining to the safety of the dam that are not covered elsewhere: |
|  |

* 1. Status of Previous Recommendations

|  |  |  |
| --- | --- | --- |
| Describe the status of each recommendation from the prevous inspection report. Were the recommendations successfully implemented? If recommendations were not implemented, document why the recommendation is no longer necessary, or identify consequences for failing to implement the recommendation | | |
| **ID** | **Recommendation** | **Status and Notes** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. VISUAL INSPECTION (*Required for all dams.*)
   1. Summary of Engineer’s Visual Inspection of the Dam and Appurtenances

|  |  |
| --- | --- |
| Date(s) of Inspection: |  |
| Inspected by: |  |
| Key Findings: |  |

**2.2 Summary of Most Recent Outlet Conduit Inspection**

|  |  |
| --- | --- |
| Date of Inspection: |  |
| Inspected by: |  |
| Type of Inspection (e.g., manned, ROV) |  |
| Key Findings: |  |

1. REVIEW OF OWNER’S OPERATION PLAN (*Required for all dams.*)
   1. Operation & Maintenance Manual

|  |  |  |
| --- | --- | --- |
| What is the date of the last update of the Operation & Maintenance (O&M) Manual for the dam? |  | |
| Does the O&M Plan include the following stage-storage-discharge curves? | | |
| Principal spillway discharge rating curve or table | [YES/NO] | |
| Auxiliary spillway discharge rating curve or table | [YES/NO] |
| Low level outlet discharge rating curve or table | [YES/NO] |
| Stage-storage relationship for reservoir | [YES/NO] |
| Provide comments on the adequacy of stage-storage-discharge curves. Note the source of the data and if it is referenced to a datum or local gage. Assess whether key dimensions and elevations are referenced on the curves and if assumed discharge coefficients are reasonable. Also note if discharge rating curves are provided for any other structures (e.g., siphons, overflow conduits). | |
|  | | |

|  |  |
| --- | --- |
| Does the O&M Manual include the following information pertaining to reservoir operation? | |
| Safe drawdown rate for the reservoir | [YES/NO] |
| Capabilities and limitations of outlet facilities | [YES/NO] |
| Authorization granted to dam tender to make operational decisions during normal, flood and emergency conditions | [YES/NO] |
| Procedures for safe operation of gates and appurtenances during normal, flood and emergency conditions | [YES/NO] |
| Plan to monitor and anticipate unusual weather and other hydrologic conditions that may impact the dam and incorporate this information into the operation plan | [YES/NO] |
| Plan for interaction with operators at other dams and reservoirs that may affect or could be affected by operations | [YES/NO] |

|  |
| --- |
| Provide comments on the adequacy of operating procedures and related information provided in the O&M Plan. Describe any deficiencies: |
|  |

|  |  |
| --- | --- |
| Does the O&M Manual include the following information pertaining to dam monitoring? | |
| Location map of all instrumentation | [YES/NO] |
| Description of all instrumentation | [YES/NO] |
| Means and methods of reservoir level measurement | [YES/NO] |
| Specified frequency of data collection for all instrumentation | [YES/NO] |
| Thresholds and action levels tied to instrumentation readings that constitute an unsafe or watch condition | [YES/NO] |
| Provide comments on the adequacy of monitoring procedures and related information provided in the O&M Plan. Describe any deficiencies. If no monitoring is considered necessary, the reasons for this judgment must be stated: | |
|  | |

|  |  |
| --- | --- |
| Does the O&M Manual include the following information pertaining to routine inspections? | |
| Plan for dam owner O&M inspections at least once per year | [YES/NO] |
| Plan for inspections after critical or unusual events | [YES/NO] |
| Checklist(s) to facilitate dam owner inspections | [YES/NO] |
| Provide comments on the adequacy of inspection procedures and related information provided in the O&M Plan. Describe any deficiencies: | |
|  | |

|  |  |
| --- | --- |
| Does the O&M Manual include the following information pertaining to maintenance of the dam? | |
| Means and methods of vegetation control | [YES/NO] |
| Mean and methods of debris removal | [YES/NO] |
| Maintenance procedures pertaining to outlet works (e.g., lubrication, repair, testing) and other critical appurtenances | [YES/NO] |
| Erosion control and repair | [YES/NO] |
| Specified frequency of maintenance activities | [YES/NO] |
| Procedures for documentation and record keeping of maintenance activities | [YES/NO] |
| Provide comments on the adequacy of maintenance procedures and related information provided in the O&M Manual. Describe any deficiencies: | |
|  | |

|  |  |
| --- | --- |
| In all other respects, does the O&M Manual appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | [YES/NO] |
|  | | |

|  |  |  |
| --- | --- | --- |
| Does the Dam Owner generally follow the O&M Manual? If not, describe needed improvements: | | [YES/NO] |
|  | | |

* 1. Owner Inspection Procedures

|  |  |
| --- | --- |
| Does the owner perform annual O&M inspections of the dam and maintain corresponding inspection reports? | [YES/NO] |
| Do owner inspection procedures and documentation appear to be adequate? If not, describe the deficiencies: | [YES/NO] |
|  | |

* 1. Emergency Planning

|  |  |  |
| --- | --- | --- |
| What is the date of the last update of the Emergency Action Plan (EAP) for the dam? |  | |
| Does the Emergency Action Plan include the following key information? | | |
| 24-hour contact information for local county officials, a professional engineer who is familiar with the dam, MT DNRC engineers, and key dam owner representatives | [YES/NO] | |
| A list of local contractors that can provide assistance and materials during an emergency | [YES/NO] | |
| Evacuation or Inundation maps that adequately show dwellings and other infrastructure that would be inundated during a dam failure | [YES/NO] | |
| Information pertaining to evacuation scenarios for non-failure high flow situations (if warranted) | [YES/NO] | |
| List any key information that is missing from the Emergency Action Plan: | | |
|  | | |
| In all other respects, does the Emergency Action Plan appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies and opportunities for improvement: | | [YES/NO] |
|  | | |

* 1. Recommendations Summary (Review of Owner’s Operation Plan)

|  |  |
| --- | --- |
| * [Add rows below if necessary. If there are no recommendations, delete this comment and state “NONE”.] | [CLASSIFY] |
|  |  |
|  |  |
|  |  |
|  |  |

1. INSTRUMENTATION & SURVEILLANCE
   1. Instrumentation Data Summary

|  |
| --- |
| Provide a summary of findings from the Instrumentation Analysis (Appendix C). |
|  |

|  |
| --- |
| Comment on methods employed by dam owner to collect and record data. |
|  |

All instrumentation data should be reviewed and documented in accordance with Montana Dam Safety guidance as specified in Technical Note 10: Analysis of Dam Instrumentation as Part of a Five Year Dam Evaluation. A summary of all available instrumentation data should be available to Montana Dam Safety upon request. Documentation to support the findings and recommendations should be included in Attachment C.

1. HIGH LEVEL SAFETY EVALUATION *(Low Consequences Dams)*
   1. Downstream Hazard Assessment

|  |  |  |
| --- | --- | --- |
| Has there been any development or significant changes in the downstream inundation area in the past five years? If yes, describe: | | [YES/NO] |
|  | | |
| Based on current conditions, does the estimation of credible persons at risk and and determination that the dam is low consequences appear to be reasonable and appropriate? Discuss below if new development may have an impact on spillway adequacy and other risk baased dam criteria. | [YES/NO] | |
|  | | |

* 1. Hydrologic & Hydraulic Adequacy Evaluation

*Spillways*

|  |
| --- |
| Describe all spillways including hydraulic capacity and performance relative to the inflow design flood: |
|  |

|  |  |
| --- | --- |
| Do spillway underdrainage systems appear to be functioning properly? clear of blockage and flowing as expected? | [YES/NO] |
|  | |

|  |  |
| --- | --- |
| Do existing spillways appear to be designed and maintained consistent with current dam safety design practices and do they appear to perform satisfactorily? If not, describe the deficiencies and make recommendations for additional analysis: | [YES/NO] |
|  | |

*Low Level Outlet Works*

|  |
| --- |
| Describe the water delivery structures and including hydraulic capacity and performance: |
|  |

|  |  |
| --- | --- |
| Are the water delivery structures consistent with current dam safety design practices and do they appear to perform satisfactorily? If not, describe the deficiencies and make recommendations for additional analyses: | [YES/NO] |
|  | |

* 1. Structural & Geotechnical Evaluation

|  |
| --- |
| Describe the dam embankment/structure, seepage control measures, foundation conditions, and other critical appurtenant structures: |
|  |

|  |  |
| --- | --- |
| Is the geotechnical design of the dam and all appurtenant structures consistent with current dam safety design practices, and do these structures appear to perform satisfactorily? If not, describe the deficiencies and make recommendations for additional analyses: | [YES/NO] |
|  | |

|  |  |
| --- | --- |
| Is the structural design of the dam and all appurtenant structures consistent with current dam safety design practices, and do these structures appear to perform satisfactorily? If not, describe the deficiencies and make recommendations for additional analyes: | [YES/NO] |
|  | |

1. DETAILED SAFETY & DESIGN EVALUATION (*Required for Higher Consequence Dams)*
   1. Hazard Potential & Hydrology

*Breach Analysis and Inundation Mapping*

|  |  |  |  |
| --- | --- | --- | --- |
| Is there a Breach Analysis and Inundation Mapping of record? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| Is meta data available that describes map development and assumptions? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |
| Is mapping adequate to evacuate the downstream public for potential flooding situations associated with the dam? If not, note the deficiencies, including any recommendations for additional detail or scenarios (e.g., spillway flow maps or clear weather breach maps): | | | [YES/NO] |
|  | | | |
| In all other respects, do the analysis of record and inundation mapping appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |

*Loss of Life Estimation*

|  |  |  |  |
| --- | --- | --- | --- |
| Is there an assessment of estimated loss of life in support of Inflow Design Flood selection? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| Does the assessment appear to be current, complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |

*Hydrologic Analysis of the Inflow Design Flood*

|  |  |  |  |
| --- | --- | --- | --- |
| Is there a hydrologic analysis of record for the Inflow Design Flood? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| Does the analysis of record appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |

* 1. Spillway(s)

*Principal Spillway Description & Assessment*

|  |  |
| --- | --- |
| Describe the principal spillway hydraulic capacity and performance: | |
|  | |
| Is the principal spillway consistent with current hydraulic and structural design practices? If not, describe the deficiencies: | [YES/NO] |
|  | |

*Auxiliary Spillway Description & Assessment (copy as needed for additional spillways)*

|  |  |
| --- | --- |
| Describe the auxiliary spillway hydraulic capacity and performance: | |
|  | |
| Is the auxiliary spillway consistent with current hydraulic and structural design practices? If not, describe the deficiencies: | [YES/NO] |
|  | |

*Total Spillway Capacity*

|  |  |
| --- | --- |
| Are the spillways hydraulically and structurally capable of passing the inflow design flood with the required freeboard? And is sufficient data available for you to make that determination? If the answer to either question is no, describe the deficiencies and/or additional data needs: | [YES/NO] |
|  | |

* 1. Low Level Outlet

*Low Level Outlet Description and Performance*

|  |  |
| --- | --- |
| Describe the overall low level outlet works including hydraulic capacity and performance: | |
|  | |
| Is the intake structure of the low level outlet (including any gates/control valves) consistent with current dam safety design practices and does it appear to perform satisfactorily? If not, describe the deficiencies: | [YES/NO] |
|  | |
| Is the outlet conduit of the low level outlet consistent with current dam safety design practices and does it appear to perform satisfactorily? If not, describe the deficiencies: | [YES/NO] |
|  | |
| Is the outlet structure (i.e., impact basin, plunge pool, etc.) of the low level outlet consistent with current dam safety design practices and does it appear to perform satisfactorily? If not, describe the deficiencies: | [YES/NO] |
|  | |

*Drawdown Analysis*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Is there a reservoir drawdown analysis of record? If so, provide the date and author of the document. | | | | [YES/NO] |
| Author: |  | Date: |  | |
| Does the analysis of record appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] | |
|  | | | | |
| Does the low level outlet have adequate capacity to draw down the reservoir in case of emergency in accordance with current industry guidance? If not, describe the deficiencies: | | | [YES/NO] | |
|  | | | | |

* 1. Dam Embankment/Structure

*Seepage Analysis*

|  |  |  |  |
| --- | --- | --- | --- |
| Is there a seepage analysis of record? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| Does the analysis of record appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |
| Does the seepage analysis indicate that the dam has adequate seepage collection and filtration? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |
| Is there a need for additional seepage analysis to better understand observed seepage or plan remedial action? If yes, describe the recommended analyses: | | | [YES/NO] |
|  | | | |
| Are there any potential internal erosion failure modes that deserve additional investigation and analysis?” | | | [YES/NO] |
|  | | | |
| Do filtering systems seem adequate? Describe potential deficiencies. | | | [YES/NO] |
|  | | | |

*Stability*

|  |  |  |  |
| --- | --- | --- | --- |
| Is there a stability analysis of record? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| Does the analysis of record appear to be complete, free of errors, and in accordance with current dam safety practices? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |
| Does the stability analysis indicate that the dam will be stable with adequate factors of safety under an appropriate range of loading conditions? If not, describe the deficiencies: | | | [YES/NO] |
|  | | | |
| Is there a need for additional slope stability analysis to confirm stability of embankment slopes or plan remedial action? If yes, describe the recommended analyses: | | | [YES/NO] | |
|  | | | | |

1. RISK ASSESSMENT

Description of Pertinent Risk Assessment Activities

|  |  |  |  |
| --- | --- | --- | --- |
| Has a formal risk assessment or potential failure modes analysis been completed for the dam? If so, provide the date and author of the document. | | | [YES/NO] |
| Author: |  | Date: |  |
| If a risk assessment has been completed, are there any findings that should be considered as part of this evaluation. If so, describe: | | | [YES/NO] |
|  | | | |

1. ENGINEER’S SUMMARY & RECOMMENDATIONS

Executive Summary of Dam Evaluation

|  |
| --- |
|  |

Reservoir Safe Operating Level

|  |  |
| --- | --- |
| What is the maximum operating water surface elevation currently allowed within the reservoir? | XX feet |
| Is the current maximum operating level appropriate? If not, provide a recommended maximum operating level and justification for the change. | [YES/NO] |
|  | |

Recommendation for Next Dam Evaluation

|  |  |
| --- | --- |
| Montana Administrative Rule 36.14.603(1)g requires that the evaluating engineer make a recommendation for the time of the next evaluation by an engineer. The minimum requirement is that evaluations must be completed at least once every five years. Is this minimum requirement appropriate for [Dam Name]? If not, provide a recommendation and justification for the timeframe of the next dam evaluation. | [YES/NO] |
|  | |

Summary of Recommendations

*Urgent Recommendations*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID No.** | | **Category** | **Engineer’s Recommendation** | **Recommended Due Date** |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |

*High Priority Recommendations*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID No.** | | **Category** | **Engineer’s Recommendation** | **Recommended Due Date** |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |

*Routine Priority Recommendations*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID No.** | | **Category** | **Engineer’s Recommendation** | **Recommended Due Date** |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |
| 2023 - |  | [CHOOSE] |  |  |

Professional Engineer Seal and Signature

I, [Name], certify that I am a professional engineer with expertise in dam safety and design. This report has been developed under my direction, and I concur with the assumptions, methods of analyses, and results of all studies documented in the report unless otherwise specified.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*SIGNATURE*

Engineer of Record: [Name]

Date:

ATTACHMENT A – PERTINENT PLANS AND BACKGROUND INFORMATION

ATTACHMENT B – VISUAL INSPECTION DOCUMENTATION

ATTACHMENT C – INSTRUMENTATION SUPPORTING DOCUMENTATION

Summary of Available Instrumentation Data

Plan View Drawing of All Instrumentation

Cross Sections of the Dam

Instrumentation Data Analysis Plots

ATTACHMENT D – OTHER DATA (INCLUDE ADDITIONAL ATTACHMENTS AS NEEDED)