



**APPENDIX 4 TILDEN MINE STOCKPILE EXPANSION
UPDATED ALTERNATIVES ANALYSIS**

5/31/2024

Updated Alternatives Analysis
Tilden Mine Stockpile Expansion
EGLE Application HPY-GN8D-M4Y1Z, Tilden Mining Company
May 31, 2024

Background

After receiving comments from the U.S. Environmental Protection Agency, Region 5 (EPA) on April 1, 2024, Tilden Mining Company (Applicant) re-evaluated and updated the project purpose and alternatives analysis relating to the proposed expansion of the development rock stockpile operation at the Tilden Mine. The project purpose and alternatives analysis provided in this document should be considered an addition to the materials submitted with the Michigan Department of Environment Great Lake and Energy (EGLE) application for permit, submittal number HPY-GN8D-M4Y1Z.

The Applicant completed a process for considering potential alternatives, which identified a revised alternative that meets the updated project purpose and results in a significant reduction in proposed wetland and stream impacts as compared to the other identified alternatives. The proposed revised alternative was presented to EGLE and EPA staff during a May 22, 2024, virtual meeting. This new proposed revised alternative is the focus of this alternatives analysis.

Project Purpose and Alternative Considerations

EPA April 1, 2024 Comment

“An applicant’s stated purpose and need should be an expression of the underlying goals for the proposed project.10 The project purpose included in the application is to expand the stockpile storage of the mine to facilitate current and future iron ore mining to accommodate the life of mine plan.”

EPA April 1, 2024 Recommendation

“The EPA recommends EGLE require the applicant consider the overall project purpose of the expansion of an iron ore mine stockpile when evaluating whether the applicant has explored the full range of practicable alternatives and require the applicant provide a more detailed description and justification of additional variables, including economic considerations, influencing the project siting and layout that would make the project impracticable. The applicant should expand its explanation of how it determined the infeasibility of alternatives. For example, the applicant should augment its evaluation of the use of on-site pits as storage as part of the life of mine feasibility and additional alternatives analysis. The EPA also recommends EGLE require the applicant evaluate an alternative that would phase the stockpile expansion, which may provide additional options, such as moving stockpiles to their destination (e.g., as part of reclamation) in smaller batches rather than expanding into the wetlands and streams.”

Applicant Response

Re-stated Project Purpose

Continue to mine and process iron ore from the Tilden Mine over the planned life of mine in a manner that is safe, technically feasible and economically competitive through the expansion of the existing stockpiling operation located near the existing ore body in order to contain development rock produced by the mining operation.

Life of Mine

The current life of mine, or Long Range Mine Plan (LRMP), for the Tilden Mine is approximately 20 years.

Required Minimum Stockpile Volume

The stockpile operation requires minimum of 473 MLT rock capacity for the current LRMP.

Alternative Considerations

The Applicant continues to implement its LRMP by developing the Tilden Mine both horizontally and vertically. To access the hematite (and historically, magnetite), that contains iron units, overburden and development rock above the ore reserve needs to be removed and piled in stockpiles as close as possible to the pit but outside areas of existing ore reserves planned for future mining. The Applicant's existing stockpiles do not have sufficient capacity to continue storing development rock in a safe manner, therefore additional stockpile capacity is necessary to meet its LRMP.

The alternative considerations are focused on the methods, means and locations of the proposed stockpiling operations. The stockpiling operation is the key consideration effecting the mining process during the LRMP. The primary basis for this evaluation is to consider aquatic resource avoidance, minimization, and mitigation of the loss of resource value and function to the extent possible.

Iron mining is a high volume/low profit margin operation. The key to success in the marketplace is mining optimization of operational efficiency thereby meeting economic requirements for a viable mining operation. Obviously, *where* to mine is the first consideration, however, *how* to mine and *when* to mine are equally important factors in consideration of possible prudent and feasible alternatives.

One of the fundamental operational components of the on-going open pit mining operation is the removal of overburden and development rock over the existing ore body. The methods used to remove the overburden is a key component in determining mining operational viability.

Key factors in prudent and feasible alternative considerations for the proposed mine stockpile operation include:

- Miner Safety
- Potential Environmental Impact Avoidance and Minimization
- Mineral Quality and Location of the Ore Body
- Mining Methods (mining operation, ore location)
- Physical Properties of the development rock
 - Weight
 - Volume of material after removal

- Stable angle of repose
- Equipment Characteristics and Limitations
- Federal, State and Local regulations
- Economics and feasibility analysis
 - Cost of existing infrastructure at Tilden Mine. The Applicant is able to efficiently mine because of the past investments at the site and in the community. Past investment gives on-going competitive advantage.
 - Costs of materials and equipment needed in place prior to start of mining operations.
 - Costs of day-to-day safe operations during the LRMP.
 - Environmental costs associated the proposed mining plan.

The distance to placement of the development rock in a stockpile must be considered in both the vertical and horizontal dimensions. The most efficient and cost-effective method of stockpiling is to stockpile the development rock in a location as close to the mine exit point as possible, thereby reducing haul time and distance and increasing miner safety (less risk of driver error). This assertion is based on consideration of known characteristics including increases in haul truck capacity, limit the need for ancillary structures, and reducing fuel consumption.

There is a point at which the haul distance from the mine exit will render a mining operation unviable for safety and cost reasons. It may be technically feasible to haul the rock for long distances, but it would not be prudent after considering miner safety, the need for specialized equipment and cost that would exceed the market viability of the mining operation.

Economic Considerations

The previously submitted application documents provide an in-depth assessment of economic consideration relating to the proposed activities. Following is further explanation of the economic considerations used to determine the threshold of viability relating to potential stockpile locations.

The economics of this project can be best evaluated by accounting for both the initial upfront costs to make the stockpile space available and usable as well as the ongoing work required to move and stockpile the development rock needed to uncover the ore resource. Stockpiling alternatives primarily affect the work done by haul trucks moving the material from the mining location to the stockpiling location. This work can be quantified by the miles traveled and truck hours required to move the planned task, which then allow for hauling costs to be estimated.

The costs associated with the mining operations can be categorized as:

- Capital Expenses (CapEx) are costs incurred through the purchase of equipment or infrastructure. These are “upfront costs” requiring immediate investment.
- Operational Expenses (OpEx) are ongoing costs incurred through employee costs, fuel, maintenance, safety training for example. These costs are ongoing and are accumulated over time.

Existing asset use must also be considered when evaluating the expansion of the mining operation. For example, the costs or benefits of using existing haul roads, location of existing infrastructure, the use of

advanced wetland mitigation measures that are attributable to the current proposed activities, or costs for land already owned.

Ultimately the cost threshold considerations are the point at which the cost of iron ore produced at Tilden Mine exceeds the cost of iron ore produced elsewhere. This threshold must be assessed over the LRMP.

The actual economic assessment is complex. There are multiple unknowable variables assumed in this evaluation because they may fluctuate wildly based on factors such as multi-national trade and demand, future technologies that may change the market, or the short- and long-term goals of the company developed by future leaders. Assessing these variables is an exercise in predicting future events today, therefore assumptions must be made to assess financial risk.

The economic assumptions used in the analysis are based on the Applicant's past performance at Tilden, performance at other Cleveland-Cliffs mines and prediction of future trends by mining experts.

The use of haul truck hours is a reasonable metric to predict future costs because it provides information over time and can be modeled. This metric incorporates calculation of an equivalent flat distance that allows comparison of the alternatives regardless of height or configuration.

Process for Considering Potential Alternatives

The Applicant implemented a multi-faceted alternative review process that included the identification and comparison of site selection factors. At the beginning of the process, the Applicant identified all large, predominantly upland areas located near the Tilden Pit that could potentially be re-purposed as a stockpile site. These locations that are primarily upland defined a "site search area". A set of site search criteria was then established to determine potential prudent and feasible alternative stockpile locations. The site selection criteria include:

- Distance from the existing ore body.
- Availability of needed minimum stockpile volume – 473 MLT
- Readily available site
- Wetland and Stream direct and indirect impact assessment
- Reasonable haul distance including consideration of uphill, downhill and flat travel.
- Feasible CapEX costs
- Feasible OpEx costs

The LRMP stockpiling process considered the site selection criteria within the site search area. The model determines the "next best" dump site for each block of mined material during the LRMP stockpiling operation allowing the mine planners to determine where and when each identified stockpile area will be used. The planners can compare alternate haul options by using an assumed speed on uphill, downhill, and flat surfaces along the available truck haul route to calculate total truck hours required to complete the task.

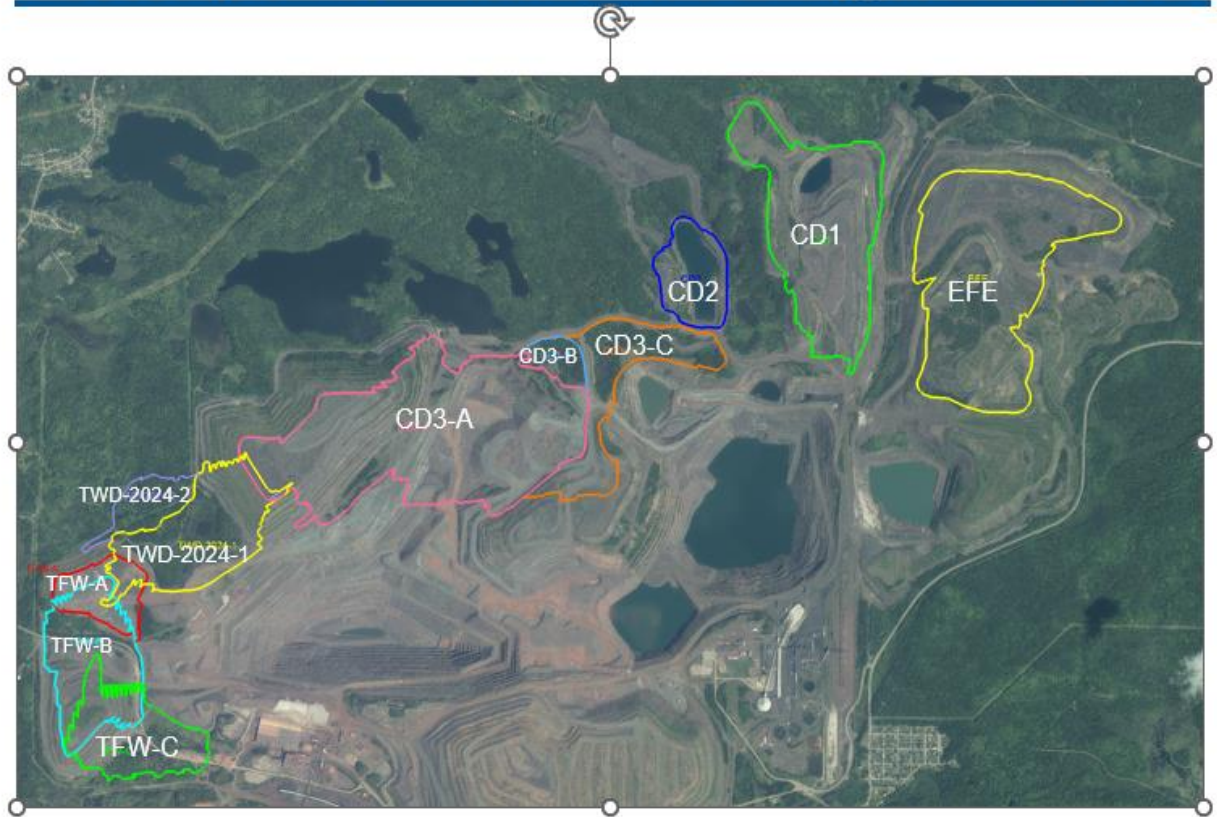
Potential stockpile designs incorporated several geometric limitations and considerations. The mining permit requires stockpiles to be constructed in 50' tall lifts with 50' wide catch benches at each lift. The loose rock being stockpiled is stable at a 36-degree angle of repose. Haul road widths are required to be a minimum of 120' for safe two-way traffic. The minimum design width for safe productive dumping operations is 200'. Considering all of these factors, stockpiles are designed within potential available footprints and maximum heights determined, and available volumes calculated.

The stockpile process modeling was an exercise in evaluating combinations of potential stockpile areas while considering the above stated site selection considerations. This process is a logistics assessment.

Regardless of which alternative is used, the available upland located close to the Tilden Mine will be used first because it is the safest and most cost-effective location. The planning process maximizes the use of upland areas, predominantly associated with existing stockpiling operations. Use or expansion of existing stockpiles is logistically efficient and more cost effective and a primary factor in wetland and stream avoidance.

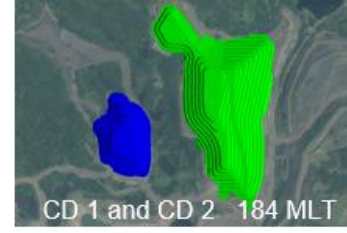
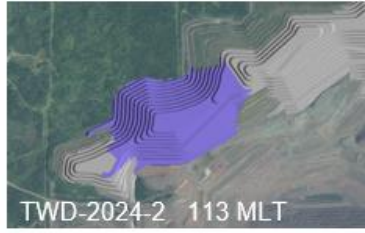
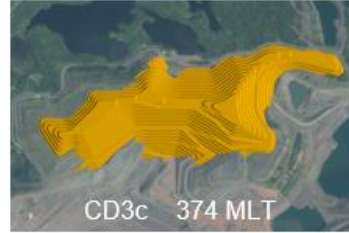
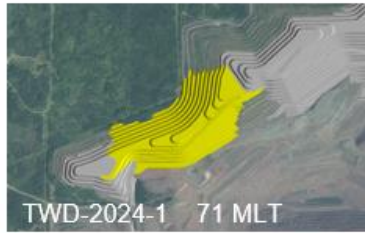
Eleven potential stockpile areas were identified within the search area.

Site Search Area – Alternative Stockpile Locations



None of the identified stockpile sites is large enough to contain the minimum 473 MLT volume needed to meet the LRMP individually. A combination of stockpile sites will be needed to achieve the required stockpile volume.

Engineering Models of Stockpiles within Search Area



Stockpile Estimated Volume by Location

Option	Stockpile Location	Capacity, MLT
1	TFW-a	12.9
2	TFW-b	75.1
3	TFW-c	121.9
4	CD3-a	283.9
5	CD3-b	301.8
6	CD3-c	374.7
7	TWD-2024-1	70.5
8	TWD-2024-2	113.0
9	CD1	144.2
10	CD2	40.2
11	EFE	117.3
12	CD1 + CD2	443.0
13	CD3-D	348.6

Stockpile Location Alternative Considerations

Empire Mine Pits

The use of the Empire Pit for Tilden Mine stockpiling operations is not an alternative because these areas are not readily available. The use of these areas is precluded due the complex ownership history and existing lease agreements. Importantly, the use of these areas would cover existing resources removing them for future development rendering such use economically impractical. The Empire Pit sites are not readily available and are cost prohibitive therefore, they have been excluded from consideration in this alternative analysis.

Far Eastern Sites – CD1, CD2 and EFE

The far eastern potential stockpile sites are readily available, upland locations. In total these sites do not contain the minimum 473 MLT volume needed. Importantly, these sites are included in potential development plans of the Empire Mine, and use of these areas would significantly reduce the asset value and future viability of the Empire Mine. Use of any of these locations, individually or in combination with other locations, would represent significant increase in truck hours used and OpEx for Tilden. Due to the longer haul distance required to use these locations, miner safety is reduced in comparison to other alternative sites. The previously submitted alternative analysis excluded from consideration these locations. Updated mine stockpile modeling provides convincing data that these alternative stockpiling locations cannot be used cost effectively. These locations are not economically nor logically viable alternatives for high volume use. These potential sites are not readily available and cost prohibitive alternatives and have been excluded from consideration as they do not meet the basic site selection criteria.

Based on considerations economic viability and impacts to the future development of the Empire Mine these alternative locations were determined not to be feasible or prudent locations and were dropped from consideration in this analysis.

CD3

CD3 is the current primary stockpiling location at the Tilden Mine. Several versions of this stockpiling location were considered in the modeling effort and are considered in this evaluation as CD3-a, CD3-b and CD3-c. This site is readily available and predominately upland. Significant infrastructure investment has been made at this location. CD3 and its variants will provide significant stockpile volume. This site is close to the Tilden Mining operation, therefore provides OpEx and CapEx efficiency. Increasing the height of CD3 is the most prudent and feasible way of reaching the needed stockpile volume while limiting the overall footprint of this area. Other alternative locations will be needed to reach the minimum stockpile volume. To maximize volume at this location, it is necessary to impact wetlands identified in the north-east corner of this stockpile area.

This site is a prudent and feasible alternative and is considered a high priority location.

TFW – Tilden Far West

TFW contains existing stockpile locations and is readily available upland. Several versions of this stockpiling location were considered in the modeling effort and are considered in this evaluation as TFW-a, TFW-b and TFW-c. The existing stockpiles will be increased in height to achieve additional volume. This site is close to the Tilden Mining operation, therefore provides significant OpEx and CapEx efficiency. Additional CapEx will be needed to move existing electric lines and entrance road to fully utilize the available volume of TFW-c. Other alternative locations will be needed to reach the minimum stockpile volume.

This site is a prudent and feasible alternative and is considered a high priority location.

TWD-2024

The TWD-2024 stockpile location is the primary focus of this application for permit. Most of the proposed wetland and stream impacts outlined in the subject permit application are associated with stockpiling at the location. TWD-2024 is readily available and a predominantly upland location. This alternative must be considered in combination with the other high priority stockpiling locations because it does not provide the required stockpiling volume alone nor would it be constructed without the use of the CD3 and TFA locations. This alternative location is required to create the total volume of stockpile space required to achieve project objectives.

The site is a high priority prudent and feasible alternative.

Combination Stockpile Configurations

To meet the LRMP stockpile volume requirements a combination of stockpile site will be needed. Based on the modeling evaluation, CD3 and TFW locations are essential stockpile locations to maximize the existing uses and economic viability. Several combinations of stockpile areas CD3+TFW+TWD-2024 may meet the project purpose and are considered prudent and feasible alternatives. Each of these areas has some amount of wetland impacts associated with them, TWD-2024 has both the largest area of proposed wetland impact and stream impacts. Based on primarily stockpile design and safety considerations the proposed wetland impacts are unavoidable.

Selected Alternative Combination of CD3-B+TFW-C+TWD-2024-1

In order to reach the necessary LRMP stockpile volume requirements it is necessary to combine alternative locations. The alternative consideration outlined above identified CD3-B and TFW-C as the primary alternatives meeting the site selection criteria and project purpose. These two alternative locations provide the best opportunity to protect miner safety, provide competitive cost considerations and minimize wetland and stream impacts. However, due to design, logistical and operational considerations, these stockpile locations do not fully create the volume required, and additional volume is needed. Among remaining alternatives, the TWD-2024 location is the next most preferred based on the site selection criteria.

The TWD-2024-1 footprint represents the LEDPA and the most feasible and prudent alternative that minimizes wetland and stream impacts to the extent possible, while providing the minimum volume required within the design requirements described above. This design was restricted to affecting one sub-watershed of Ely Creek. Larger footprints provide greater economic favorability but have higher environmental impacts.



TILDEN MINE JPA

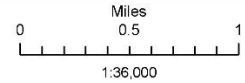
Revised Preferred Stockpile Expansion

Legend

- Revised Preferred Stockpile Expansion Outline
 - Direct Stream Impacts - 1,586 ft.
 - Ely Creek (Not Impacted)
- Wetland Impacts - 55.55 Acres**
- Emergent - 31.05 Acres
 - Forested - 6.38 Acres
 - Scrub-Shrub - 18.12 Acres
 - Non-Regulated Wetlands

Reference

Data provided by: Cleveland Cliffs Inc. and North Jackson Company
 Basemap: Satellite image dated May 30th, 2019
 Projection: State Plane Michigan North FIPS 2111 Ft. Intl.
 Datum: NAD 1983



CLEVELAND-CLIFFS INC.

North Jackson Company
 ENVIRONMENTAL SCIENCE & ENGINEERING

Proposed Revised Alternative



Option	Name	Capacity Used, MLT	Elevation
3	TFW-c	117	1950
7	TWD-2024-1	71	2040
5	CD3-b	286	2090



Revised Preferred Alternative Wetland and Stream Impact Description

The preferred alternative design objective is to reduce the stockpile footprint to the smallest expansion area possible to meet the project purpose of achieving the updated LRMP. This goal is achieved through a designed reduction in development rock stripping and stockpiling capacity to 473 MLT. To achieve a smaller expansion acreage footprint, the design extends the West Stockpile to a higher target elevation of 2,040 ft. MSL and further maximizes the storage capacity of the CD3 pit stockpile by increasing its maximum elevation to 2,040 ft. MSL. The Tilden Far West stockpile is expanded with increased elevation to 1,950 feet MSL. The option requires Tilden access road (CR PE) and powerline relocation.

Revised Preferred Alternative Impact Summary

Environmental Evaluation Factors	Estimated Quantity	Units
Regulated Wetland Impacts	55.6	Acres
Stream Impacts	1,586	Lineal Feet
Stockpile New Expansion Footprint	176.6	Acres
Maximum West Stockpile Elevation	2,040	Ft MSL

Wetland Impacts

- Wetland impacts are significantly reduced from all alternatives and occur within one sub-watershed

of Ely Creek

Proposed Wetland Impacts

Alternative Wetland Type	Emergent	Wetlands Impacted			
		Forested	Scrub-Shrub	Total Regulated	Unregulated
Acreeage	31.1	6.4	18.1	55.6	5.15

Summary of Republic Wetland Preserve Wetland Mitigation Use

Total Wetland Credits at Republic Wetland Preserve	Type				Total (acres)
	Preserved Wetlands (acres)	Forested Wetlands (acres)	Scrub-Shrub (acres)	Emergent & Aquatic Bed (acres)	
Acres Initially Available	21.0	239.3	104.8	313.4	678.5
Acres Used	0.7	163.8	43.3	182.1	389.9
Balance Available (12/31/23)	20.3	75.5	61.5	131.3	288.6
Empire Permit WRP017312 2019	--	20.6	3.3	42.6	66.5
Mitigation Ratio Multiplier	--	2.0	1.5	1.5	--
SubTotal Debits	--	41.2	5.0	63.9	110.1
Credits Remaining	20.3	34.3	56.6	67.4	178.6
Tilden Stockpile Expansion 2024		6.4	18.1	31.5	56.0
Mitigation Ratio Multiplier	--	2.0	1.5	1.5	--
SubTotal Debits	--	12.8	27.2	47.3	87.2
Credits Remaining	20.3	21.5	29.4	20.2	91.4

Surface Waters Impacts

- Lowest surface water direct impacts (1,586 linear feet of perennial streams) in one sub-watershed of Ely Creek.

Stream Segment Direct Impacts

Stream ID	Flow Regime	Bankfull Width (feet)	Maximum Pool Depth (inches)	Length within Project Area (feet)
B2	Perennial	6	24	1,586
			Total	1,586

Functional feet of stream impact for the alternative has been calculated using the MiSQT debit tool. This calculation includes both direct impact from stream channel fill and indirect impact from seep water collection for the expansion of the Tilden SSMP BMP system for this project for a total cumulative debit of 1,649 functional feet of loss.

SUMMARY OF MISQT DEBIT TOOL TABLE (GEI, 2024)

DEBIT TOOL TABLE				
Sub-Reach	Existing Stream Length (ft)	Existing Condition MISQT Score	Proposed Condition MISQT Score	Functional Feet (Debit)
B2a - Direct	468	0.86	0	402.48
B2c - Direct	868	0.81	0	703.08
B2c - Indirect	53	0.81	0.71	5.3
B2d - Indirect	857	0.86	0.76	85.7
B2e - Indirect	1349	0.86	0.76	134.9
B2e - Direct (In Seep Collector Footprint)	250	0.83	0	207.5
B2- Indirect	1,101	0.83	0.73	110.1
Total Functional Loss (Debits in FF):				1,649

CHANNEL RESTORATION PHASE	REACH	EXISTING / PROPOSED STREAM TYPE	TOTAL EXISTING STREAM LENGTH (FT) ^a	EXISTING MISQT SCORE ^b	PROPOSED STREAM LENGTH (FT) ^c	PROPOSED MISQT SCORE ^d	CREDIT LENGTH (FT)
PHASE I	VD01	E/E	1,364	0.28	1,855	0.59	713
PHASE I	VD01 - POND	POND/E	533	0.23	825	0.59	364
PHASE I	VD02	B/E	220	0.29	650	0.57	307
Phase I	VD02- POND THROUGH CULVERT 8	POND/E	500	0.19	650	0.57	276
PHASE I TOTAL			2,617	--	3,980	--	1,660
PHASE II	VD02 - POND	POND/E	1,761	0.19	2,725	0.57	1,219
PHASE II	VD02- TRIBUTARY	NONE/E	0	0.14	500	0.58	290
PHASE II	VD03	C/E	1,514	0.51	1,825	0.60	323
PHASE II	VD03 - POND	POND/E	458	0.24	640	0.60	274

Summary of Proposed Stream Mitigation Existing and Proposed MISQT Credits (GEI, 2024)