

**Primrose Creek Restoration Project
Channel Elevation Discussion
New Hope Crushed Stone Quarry
Solebury Township, Bucks County, Pennsylvania**

The Pottsville District Mining Office of the Pennsylvania Department of Environmental Protection is requesting Waiver 16 approval under 25 PA Code Chapter 105.12(a)(16) for a proposed stream restoration project on the site of the forfeited New Hope Crushed Stone quarry permit and property in Solebury Township, Bucks County, PA. The Pottsville District Mining Office is responsible for reclaiming the site in order to close the quarry's mining permit. During quarry operations, the flow of Primrose Creek was altered after the quarry was permitted to expand the quarry pit through the creek. Water flowing into the quarry pit from upstream reaches of Primrose Creek would be pumped to the downstream reach of Primrose Creek. As such, the restoration of Primrose Creek is a component of the proposed reclamation of the entire site. Pursuant to this effort, the Pottsville District Mining Office is submitting the following information as justification for the waiver.

An approximately 435 feet long, two-tiered channel and floodplain is proposed to restore Primrose Creek to natural flows by connecting the now water filled quarry pit with the downstream reaches of Primrose Creek. The lower tier will be designed to accommodate a 10-Year storm and the flood plain upper tier will be designed to accommodate a 100-Year storm without allowing the water level in the quarry pit to increase more than 1 foot above the interpolated 100-year flood elevation of 103.0' MSL, [See FEMA Flood Insurance Study, Bucks County, PA , 2015, (Rev 2017), Flood Profile Chart in Appendix 1, Exhibit 3, Plate 1]. The horizontal alignment and vertical alignment of the proposed channel have been chosen to ensure it will discharge at least a 100-year storm and reside in the native soil beneath the spoil material surrounding the quarry. The proposed channel has been designed based on the following:

DEP has used the following studies to determine the invert elevation of the channel at the quarry edge and properly size the channel to accommodate flows from the upstream reaches of Primrose Creek:

- A December 9, 2022 (Revised January 30, 2023) Tetra Tech, Inc. Findings Letter Report - Quarry Discharge Outlet study and drawings of the Primrose Creek Watershed and natural soil elevation data obtained from six test pits dug along the Eastern rim of the quarry and along the proposed channel path. [See Appendix 1, Exhibit 4]
- An August 3, 2023 Tetra Tech, Inc. Supplementary Field Exploration obtaining additional natural soil elevations obtained from an additional six test pits. [See Appendix 1, Exhibit 5]
- A September 19, 2023 Tetra Tech, Inc. comment letter on behalf of Solebury School urging the outlet elevation to be set at 98' MSL or above. [See Appendix 1, Exhibit 6]
- An August 22, 2017 Assessment of the Currently Proposed Post Mining Water Level in NHCS Quarry Pit [See Appendix 1, Exhibit 7]
- A December 2023 Michael Baker International Primrose Creek Restoration Project Hydraulic and Hydrologic Letter Report Final [See Appendix 2]

In addition, Department Staff provides the following comments and calculations in support of the decision to propose the quarry outlet elevation at 98.00 feet MSL with the final elevation to be determined by the elevation of the native soil surface to be discovered when excavation for the channel begins.

- Historic aerial and satellite photographs of the quarry site. [See Appendix 1, Exhibit 1, Plates 1-10]

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- Historic mine maps and mine permit data for the quarry. [See Appendix 1, Exhibit 2, Plates 1-5a-5d]
- Calculations and figures and drawings [See Appendix 1, Exhibit 3, Plates 1-10]

Channel Description

A horizontal alignment of a straight line between the pit and the beginning of the downstream reach was selected for the following reasons:

- A straight line is the shortest distance between two points. The shorter the distance the less construction materials, e.g. rip rap, geotextile material, etc., needed, which minimizes the cost of construction.
- Any bends would require additional armoring to resist erosion from the energy of the water.

A vertical alignment that:

- Situates the proposed stream bed and floodplain in native soil because the spoil material lacks organic content necessary for vegetative growth.
- Has an average slope that is similar to that of the downstream reach to minimize turbulence.

Minimum Average Slope and Minimum Channel Invert

The minimum average slope of the proposed channel and, in turn, its minimum invert elevation at the rim of the quarry, was estimated using survey points and test pit data provided by Tetra Tech, Inc. Those survey points include:

- Test Pits TP-1, TP-2, TP-3, TP-4, TP-5, TP-6, TP-A1, TP-A2, TP-A3, TP-A4, TP-A5, TP-A6 [See Exhibit 3, Plate 2,3,4]
- Numerous surface survey points
- Undisturbed downstream Primrose Creek channel natural elevations [See Appendix 1, Exhibit 3, Plate 7]

After review and compilation of the study data, the elevations chosen for determining the minimum slope hinged on the data from these two points.

- 93.0' MSL - Test Pit TP-A3 [Appendix 1, Exhibit 3, Plate 2, Circled]
- 90.9' MSL - Tie-in Point of proposed channel with Primrose Creek [Appendix 1, Exhibit 3, Plate 3, Circled]

The excavation of Test Pit TP-A3 during the Tetra Tech, Inc. July 2023 geotechnical investigation revealed a 42" Reinforced Concrete Pipe (RCP) culvert. [See Appendix 1, Exhibit 3, Plate 6] The native soil/bottom of pipe was surveyed at 93.0 feet MSL. A review of the DEP permit mapping and reclamation plans included in permit revision submissions to DEP show that a 42" RCP culvert conveying Primrose Creek under a haul road as shown in a 1998 survey by Thomas H. Crews, Inc [Appendix 1, Exhibit 2, Plate 4] is in the same location where Tetra Tech, Inc. discovered the 42" RCP culvert in 2023. DEP is confident that

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Test Pit TP-A3 was excavated into a section of the stream bed of Primrose Creek as relocated by New Hope Crushed Stone

The following were developed by DEP staff in their review of the data obtained in the field by consultants, Tetra Tech, Inc. and Michael Baker International.

- Plan and Profile sheet of Primrose Creek from Michael Baker survey with Tetra Tech's survey superimposed both in plan and profile views. [See Appendix 1, Exhibit 3, Plate 8] Each test pit was located on the Plan view of baseline, then projected onto the profile at the appropriate stationing. The station was determined in plan view by extending a straight line from each test pit location to the baseline. The stationing of the test pit is where the drawn line crossed the baseline.
- The tie-in point of Tetra Tech's proposed channel design and the Primrose Creek was incorporated into the Plan & Profile provided by Michael Baker International (STA. 5+17.07). This point on the Michael Baker plans coincides with STA. 0+00 of the baseline contained on Tetra Tech's Proposed Site Plan received on 01/20/2023. [See Appendix 1, Exhibit 3, Plate 3, circled] The stream profile provided by Michael Baker was used to determine the slope of the downstream reach of Primrose Creek. [Appendix 1, Exhibit 3, Plate 8]
- Before mining operations began, it is evident by review of aerial photos from past decades that the Primrose Creek flowed across the property approximately 150-200 feet south of and somewhat parallel to the baseline of the proposed channel. [See Appendix 1, Exhibit 2, Plates 1,2,3,4] It must be noted that the prior owners of the property as well as the New Hope Crushed Stone Co. relocated Primrose Creek from its original path shown on the 1938 aerial photo as operations required. In addition, the Primrose Creek path as relocated by New Hope Crushed Stone was shown on mining plans dating back through the 1980's and 1990's, even though the size of the creek is not noted. [See Appendix 1, Exhibit 2, Plate 5]
- The locations and labels of each test pit and their respective native soil elevations observed during excavation were located by Department staff onto Google Earth for review. The baseline of the proposed channel was also referenced into the Google Earth image. The original topography may be inferred by noting the decrease of native soil elevations as one reads the values from north to south. Note that there is an inflection point approximately 150-200 feet south of and parallel to the baseline of the proposed channel. This is the location of T-6 and TP-A3 and is also the apparent location of the flow path of the Primrose Creek. As one moves further south from TP-6 and TP-A3, the native soil elevation increases sharply. [See Appendix 1, Exhibit 3, Plate 5 Google Earth image with native soil contours]
- During a meeting among DEP representatives with Solebury School representatives in March of 2023, Solebury School's Consultant Engineer, Michael J. Byle P.E. stated that the native soil

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elevation of 92.5 feet MSL observed at TP-6 in June of 2022 should be disregarded, positing that a high-wall failure occurred at this location rendering the native soil elevation artificially low. DEP inserted the test pit locations onto Google Earth using Tetra Tech, Inc. Survey data and compared their locations on previous aerial images geo-referenced to Google Earth by DEP staff. [See Exhibit 1, Plates 6,7,8] In doing so, it can be observed that the high- wall failure mentioned by Michael Byle, P.E. may have occurred West of TP-6.

However, georeferenced images provided by Mr. Byle show that TP-6 was located within the highwall failure area. [See Appendix 1, Exhibit 1, Plates 9 and 10] DEP decided to abide by Mr. Byle's request of not using elevation data from TP-6 to calculate the elevation of the proposed channel.

- In addition, an initially proposed invert elevation (93.3 feet MSL) for the outlet channel at the quarry edge conflicted sharply with the quarry outlet elevation (106 feet MSL) proposed by Mr. Byle in the August 22, 2017 "Assessment of the Currently Proposed Post-Mining Water Level in NHCS Quarry Pit" [See Appendix 1, Exhibit 7]
- Since the excavation of TP-A3 uncovered the culvert installed by New Hope Crushed Stone to convey the Primrose Creek, the data from TP-A3 is suitable to use to calculate the slope of the proposed channel that is similar to that of Primrose Creek. The native soil elevation at TP-A3 was noted at Elevation 93.0 feet. As discussed above, the relative stationing for TP-A3 is STA. 3+27 on the Plan & Profile provided by Michael Baker International [Appendix 1, Exhibit 3, Plate 8].
- A proposed minimum slope of 1.1% was calculated using the difference in elevations between the native soil elevation at TP-A3 and the stream elevation at the tie-in point, divided by the distance along the baseline between the two points. $S = (93.0 \text{ feet} - 90.9 \text{ feet}) \div 190 \text{ feet} = 0.0111 \text{ ft/ft}$. Using the calculated proposed minimum slope of 1.1% and the baseline alignment and tie-in point elevation (90.90 feet MSL) provided by Tetra Tech, Inc., the minimum invert elevation of the proposed 435' long channel at the rim of the quarry was calculated to be 95.70 feet MSL.

The calculated minimum slope of 1.1% was then compared with the existing slope of Primrose Creek. The downstream slope of Primrose Creek was reviewed over various lengths, from ~100 feet to ~450 feet. Slopes from 0.6% to 2.2% were observed, noting that the slope tends to decrease as the length of stream under review increases. Comparing the downstream slope of Primrose Creek with the slope of the proposed channel shows that the two are similar [See Appendix 1, Exhibit 3, Plates 7 and 9]

Maximum Average Slope, Maximum Channel Invert and Channel Elevation Profile

Given the variability of the elevations where native soil was encountered in the numerous test pits, it has been decided to set a target elevation of the quarry invert at 98' feet for the purposes of channel design. The actual elevation of the quarry invert will be determined during excavation of the channel

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itself and where native soil will be uncovered as excavation progresses as per the Construction Notes found in Appendix 1, Exhibit 3, Plate 10

The section view of test pits provided by Tetra Tech in a drawing submitted on August 3, 2023 [Appendix 1, Exhibit 3 Plate 4] was used to review the appropriateness of the floodplain elevations relative to native soil elevations, with the aim of establishing the floodplain in native soil to assure vegetative growth. Tetra Tech, Inc. has inferred that the natural ground elevation at the location of Profile B [See Appendix 1, Exhibit 3, Plate 3] is nearly horizontal between TP-A4 and TP-A6 at 97.9' to 97.7' MSL with no defined channel for the historic Primrose Creek. Using a target 98.0' MSL elevation for the quarry outlet invert and 90.9' MSL for the 435' channel outlet invert, the average slope of the channel would be 0.0163 ft/ft or 1.63% which is within the range of downstream Primrose Creek slopes observed.

Using a 98' MSL channel Invert at the edge of the quarry and a channel and floodplain wide enough to pass a 100 year flood with a maximum flow depth of three feet, the quarry water level will rise to an elevation of 101' MSL which is less than the 103' MSL 100-year flood elevation. This will provide a 2' margin should the water rise in the quarry rise above 101' MSL.

Also noted on the same sheet under Channel Installation is "At the connection of the new and existing stream channel, the new channel will be graded to match geometry (width, depth, slope) of the existing channel for Primrose Creek." [Appendix 1, Exhibit 3, Plate 10] Therefore, the data obtained from the field governed the determination of slope and elevation of proposed channel in order to restore Primrose Creek.

Appendices for Reference

Appendix 1: Channel Elevation Discussion and Tetra Tech Studies

Exhibit 1: Historical Aerial Photographs and Satellite Images georeferenced to Google Earth showing Primrose Creek and locations of test pits

Plate 1: 1938 NRCS Aerial Photograph

Plate 2: 1953 NRCS Aerial Photograph

Plate 3: 1971 NRCS Aerial Photograph

Plate 4: 1983 Satellite Image

Plate 5: 2002 Satellite Image

Plate 6: 2015 Satellite Image

Plate 7: 2018 Satellite Image

Plate 8: 2023 Satellite Image

Plate 9: 2014 Tetra Tech Aerial Image

Plate 10: Tetra Tech Interpretation of Natural Ground Elevations

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Exhibit 2: Historic New Hope Crushed Stone Quarry mine maps with locations of test pits superimposed and showing path of Primrose Creek

- Plate 1: 1985 Bonding Map
- Plate 2: 1992 Bonding Map
- Plate 3: 1996 Operations Map
- Plate 4: 1998 Reclamation Map
- Plate 5: Mine Map Collection

Exhibit 3: Additional Information

- Plate 1: 100 Year Flood Elevation at Quarry Edge
- Plate 2: Table 1: Test Pit Data
- Plate 3: Tetra Tech Test Pit Profile
- Plate 4: Tetra Tech Test Pit Profile
- Plate 5: Test Pit Locations and baseline
- Plate 6: Test Pit TP-A3 Culvert Photo
- Plate 7: Downstream Primrose Creek Elevations
- Plate 8: Baker Profile with Test Pits
- Plate 9: Baseline Elevations at 1.1 % slope
- Plate 10: Tetra Tech General Construction Notes

Exhibit 4: Tetra Tech: Findings Letter Report, January 30, 2023

Exhibit 5: Tetra Tech: Supplemental Field Exploration Memo, August 3, 2023

Exhibit 6: Tetra Tech: Quarry Pit Discharge Level, September 19, 2023

Exhibit 7: Assessment of the Currently Proposed Post-Mining Water Level in NHCS Quarry Pit, August 22, 2017

Appendix 2: Solebury Township Comment Letter and Response

Appendix 3: Michael Baker International, Hydrologic and Hydraulic Report. December 2023