STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

IN THE MATTER OF FRONTIER STONE, LLC,

DEC File Nos. 8-3436-00033/00001; 8-3436-000033/00002

PETITION FOR FULL PARTY STATUS

This Petition is submitted on behalf of the Town Board of the Town of Shelby, in accordance with 6 N.Y.C.R.R. § 624.5. The Town of Shelby regulates, to the extent allowed under the Mined Land Reclamation Law and other state and local laws, all mining facilities within the Town.

Information required by 6 NYCRR § 624.5(b)(1):

i) Identify the proposed party together with the name of the person who will act as a representative of the party.

The proposed parties are the Town Board of the Town of Shelby and the Town of Shelby (collectively the "Town" or "Petitioner"). Their representatives are:

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ii) Identify petitioner's environmental interests in the proceeding.

Petitioner is an involved agency for purposes of the review of this application under the State Environmental Quality Review Act (SEQRA) as the governing body for the Town of Shelby. Petitioner is charged by State law with protecting the health, safety and welfare of the residents of the Town of Shelby. Petitioner's environmental interest involves all impacts that may result from the location of the proposed mining facility within the Town.

Petitioner, acting through its Town Board, regulates the location of land uses within the Town through its Comprehensive Plan and zoning code, including mining. Mining facilities within the Town of Shelby are restricted to mining/excavation overlay districts, which may only be created in industrial zoning districts, upon an applicant's submission of an application to create such an overlay district (the site is currently not zoned Industrial nor in a Mining/Excavation Overlay District). In addition, part of the review process for these applications includes Town approval of a proposed site plan for the mine as well as a special use permit. While the Town's decision-making record is not limited to the DEC record, portions of the DEC record – particularly the DEIS and FEIS – are important and indispensable portions of the Town record. The Town Board is also responsible for implementing the Town Comprehensive Plan.

DEC is the lead agency for this application and responsible for the FEIS. Accordingly, the Town's environmental interest includes the proper production of the FEIS, and many of the issues raised herein concern the numerous defects in the DEIS identified at public hearings and in comments submitted to the DEC.

iii) Identify any interest relating to statutes administered by the department relevant to the project:

The primary interest under the statutes is Petitioner's interest in the DEC's proper implementation of the law and regulations under Environmental Conservation Law Article 23, Article 19, Article 15 and Article 71, and 6 NYCRR Part 201, 212, 422, 608, 617, 621 and 624. To the extent administered by the DEC, the applicable provisions of the Clean Water Act, as amended.

Additionally, the State Environmental Quality Review Act (SEQRA), Title 8 of the Environmental Conversation Law, governs the environmental review of the application. Under the process created by that law and the DEC's implementing regulations, the DEC is the lead agency. Accordingly, the Town Board has, in order to carry out its legal obligation as well as on behalf of the residents of the Town, a substantial interest in the manner in which the DEC carries out its responsibilities.

iv) Identify whether the petition is for full party or amicus status.

This petition is for full party status.

v) Identify the precise grounds for opposition or support.

For the reasons discussed more fully below, the Town is moving for full-party status to have the Applicant resolve deficiencies in the mined-land use plan ("MLUP") and DEIS, portions of which are ten years old, oppose issuance of the Draft Permit in its current form, and seek additional permitting conditions, or denial of the permit. For these issues, some of the areas of environmental concern overlap. Many of the SEQRA issues call for additional information or studies by the Applicant or disinterested third parties, and can therefore be resolved by submission of that information by the applicant, or corrections within the FEIS. Unresolved SEQRA issues are adjudicable in the same manner as other issues raised herein, pursuant to Part 624.4(c)(6)(i)(b).

Additional information required by 6 N.Y.C.R.R. § 624.5(b)(2)(i) and (ii):

The Town is required to identify an issue for adjudication which meets the criteria of section 624.4(c) of this Part, and provide an offer of proof specifying the witness(es), the nature of the evidence the person expects to present, and the grounds upon which the assertion is made with respect to that issue. Per 624.4(c), an issue is adjudicable if "it is proposed by a potential party and is both substantive and significant." 6 NYCRR 624.4(c)(1). An issue is "substantive" where "there is sufficient doubt about the applicant's ability to meet statutory or regulatory criteria applicable to the project, such that a reasonable person would require further inquiry." 6 NYCRR 624.4(c)(2). An issue is "significant" where "it has the potential to result in the denial of a permit, a major modification to the proposed permit or the imposition of significant permit conditions in addition to those proposed in the draft permit." *Id.*

Two adjudicable issues exist which support the Town's petition for full party status in this matter: (I) First, the DEIS and MLUP are deficient since the Applicant failed to address the potential environmental effects of the project and/or propose adequate environmental mitigation measures as required by SEQRA. (II) Second, the draft permit in its current form is deficient since it does not adequately protect the Town or its residents from potentially adverse environmental effects that could result from the proposed mine.

I. THE DEIS AND MINED LAND USE PLAN DO NOT ADEQUATELY ADDRESS THE POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED MINE.

DEC is responsible for reviewing applications for mining permits. 6 NYCRR 422.1. As part of the application process, each entity seeking a mining permit is required to submit a mined land-use plan ("MLUP"). In part, the MLUP must contain a description of the applicant's proposed methods for preventing pollution, reducing soil erosion, and minimizing the effect of mining on the people in the surrounding area, as well as plans for protecting the natural resources of the state, including soil, forests, water, fish, wildlife, and all aquatic or terrestrial related environments. 6 NYCRR 422.2(c)(4). As the lead agency in this instance, DEC is also charged with performing the SEQRA analysis for the proposed mine. SEQRA requires an analysis of the potential social, economic, and environmental impacts of a proposed project. NY ECL § 8-103. As part of the SEQRA review process, an applicant is required to prepare and submit a draft environmental impact statement, or "DEIS". 6 NYCRR 617.9. Like the MLUP, the DEIS examines the potential environmental impacts of a project, as well as lists proposed mitigation measures to minimize said impacts. *Id.* DEC is empowered by SEQRA to deny a permit for a facility which, even after proposed mitigation measures, will have clear adverse environmental and socioeconomic impacts.

For mining projects, the submission of a mined-land use plan, in conjunction with the DEIS, assists the DEC in assessing the environmental impacts of the proposed project, as well as the measures proposed by the Applicant to mitigate those impacts. Since several portions of the MLUP and DEIS analysis overlap in this regard, they will be considered together for purposes of performing a SEQRA analysis on the proposed mine. *See, e.g.*, *In the Matter of Sour Mountain Realty, Inc.*, 1996 N.Y. Env. LEXIS 14, at *13 (DEC July 18, 1996).

The Town is particularly concerned about the impact the project would have on two of the Town's unique local resources: the Iroquois National Wildlife Refuge ("INWR"), a 10,828 acre federal wildlife preserve created in 1958 located immediately south of the proposed mine, and the Iroquois Job Corps Center ("IJCC"), an educational and career technical training program administered by the U.S. Department of Labor, located southeast of the proposed mine. Also of concern is the failure of the DEIS to adequately explore alternatives to the proposed mine and/or the cumulative environmental impact of the mine in conjunction with other local activities.

The Town will present evidence discussing the conflict between the location of the mine next to these important resources through the specific areas listed below, including, but not limited to noise, dust, traffic, impact on wildlife, impact on drinking water and hydrogeologic concerns. The Town was assisted in compiling this petition by its expert witness Sterling Environmental Engineering, P.C.

As part of the adjudicatory process, the Town will submit legal authority supporting the denial and/or requiring significant modification of the draft mining permit based on documented environmental concerns. The Town will argue that the significant unavoidable impacts that will occur (discussed further below), mandate denial of the permit, and/or require significant modifications of the draft permit.

During the adjudicatory hearing, the Town will also present documentary evidence demonstrating that the impact of the mine requires denial and/or modification of the requested mining permit. Part of that evidence will concern the hydrogeologic, wildlife, aesthetic, noise, wetlands and other impacts (partly) addressed in the DEIS and other studies, and explained in greater detail later in this Petition.

The Town believes that the documents attached form the minimum considerations the DEC should rely on in evaluating impacts to the Town and its local resources. Included in this Petition will be the following:

(1) Letter and expert analysis from the U.S. Department of Interior, Fish and Wildlife Service dated June 6, 2014 (attached as **Exhibit A**);

(2) Letter from the U.S. Department of Labor Letter to N.Y.S. Department of Environmental Conservation dated June 2, 2014 (attached as **Exhibit B**);

(3) Email from U.S. Department of Interior, Fish and Wildlife Service to N.Y.S. Department of Environmental Conservation dated November 25, 2015 (attached as **Exhibit C**);

(4) Letter from Hodgson Russ LLP on behalf of the Town of Shelby to N.Y.S Department of Environmental Conservation dated June 9, 2014 (attached as **Exhibit D**);

(5) U.S. Department of the Interior, U.S. Geological Survey, Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009-2010, dated 2012 (attached as **Exhibit E**); and

(6) Letter from Orleans County Soil & Water Conservation District to Orleans County Highway Department dated February 11, 2016 (attached as **Exhibit F**).

In addition, the Town intends to call the some or all of following witnesses at the Hearing:

(1) Mark P. Millspaugh, P.E., Sterling Environmental Engineers, P.C.; and

(2) Merle Draper, Town Supervisor for the Town of Shelby.

The Town believes that the deficiencies in DEIS and mined land use plan create adjudicable issues for the following reasons:

A. The DEIS and MLUP Do Not Adequately Address the Potential Impacts of the Mine on the INWR.

The mission of the national wildlife refuge system is "to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. U.S. Fish & Wildlife Service (hereafter, the "USFWS"), National Wildlife Refuge System, "About: Mission, Mission Statement", http://www.fws.gov/refuges/about/mission.html. The INWR was created in 1958 in furtherance of this mission. The USFWS purchased the land to create the INWR using funds from the sale of migratory bird stamps. U.S. Fish & Wildlife Service, "Buy a Duck Stamp, Save Land", http://www.fws.gov/northeast/duckstamp2007.html.

The primary purpose of the INWR is to serve as nesting, feeding, resting and staging areas for migratory waterfowl. The INWR contains various habitats that support over 250 species of birds, 42 species of mammals, plus reptiles, fish, amphibians and insects. The refuge is used by Town residents for recreation, hunting, fishing and bird-watching. The INWR is home to at least one "endangered" species (the short-eared owl), and at least four "threatened" species (the Bald Eagle, Northern Harrier, Henslow's Sparrow, and Northern Long Eared Bat). The Town cannot overstress that the INWR is a highly unique and recognized environmental resource. Indeed, the INWR is one of only ten national wildlife refuges within the State of New York. U.S. Fish & Wildlife Service, Refuge List by State, New York (last visited Feb. 22, 2016), https://www.fws.gov/refuges/profiles/ByState.cfm?state=NY.

Negative Effects on Recreation and Wildlife.

The Applicant's submissions with respect to the potential impact on the INWR – Appendix 6 to the DEIS and Section 2.2 of the MLUP – fail to address the wide range of potential impacts to recreation and wildlife that a mine would have on the INWR. The MLUP does not discuss the potential impacts of the mine on the INWR at all.

At best, the DEIS makes a half-hearted effort to address those impacts. First, the DEIS does not properly address the effects that the mining operation could have on recreational use of the INWR. The DEIS assumes that hiking, fishing, and canoeing will be conducted outside of the proposed mine's "area of influence," or "AOI" – therefore, the impacts to those activities were not discussed. DEIS Volume 1, at p. 15. The Applicant's basis for limiting its analysis to the AOI, or how the delineated area was established, is not entirely clear.

Furthermore, the parts of the INWR that are suitable for hiking, fishing, birding, and, to a certain extent, canoeing, are subjective considerations. Therefore, it was improper for the Applicant to disregard the effect of the proposed mine on these activities. *Id.* at pp.15-16.

As for bird watching, the Applicant admits that this activity would be affected by the increase in truck traffic, but otherwise fails to address or determine the scope of that impact, simply stating that it would be "minimal." *Id.* This is hard to believe since the mine would result in an increase in truck traffic by approximately 60 truck tips per hour down the same road where two of the four bird-watching overlooks on the INWR are located. Ex. A at p.4.

Though hunting is allowed within the AOI, the Applicant says that the impact to the same will not be significant. No authorities or studies are cited to support this conclusion. DEIS Volume 1, at p. 15. It is equally hard to imagine how hunting, which traditionally relies on minimal noise and disturbance, would not be affected by the sounds from an operational mine, which include blasting, stone crushing, and a constant flow of truck traffic in and out of the project site. Ex. A at pp. 4-5.

For nearly 60 years the INWR has provided the public with the opportunity to fish, hike, hunt, bird watch, etc. in a unique natural setting. Siting a large rock quarry on the edge of the INWR will have a significant negative impact on the natural environment which people seek. Fishing, hiking, bird watching and hunting will simply not be the same due to the noise, dust and water discharges caused by the mine. Further, the associated truck traffic to/from the mine will directly impact people and wildlife within this pre-existing sanctuary. A quarry of this size in such close proximity to the INWR is simply an incompatible land use.

Second, the DEIS does not adequately address the potential impact to wildlife in the INWR. Many of the studies performed by the Applicant, such as those pertaining to the endangered short-eared owl, are nearly ten years old and should be updated to accurately reflect current conditions at the project site. *See, e.g.*, DEIS Volume 4, Vegetation and Wildlife Resources and Impact of Analysis of Ecological at p.4. Other effects, such as the varying impacts that certain construction activities can have in different seasons, appear to have been overlooked by the DEIS. *See* Ex. F (discussing how it is necessary to avoid winter excavation in roadside ditches to prevent disturbance of short-eared owl nests).

Further, many of the Applicant's statements with respect to the potential impact on wildlife in the INWR are either substantively lacking, disingenuous, or in fact completely false. Ex. A at p. 4. As noted by the USFWS, the Applicant repeatedly misquotes authority within the DEIS, incorrectly relies upon them for the propositions cited, or relies on studies that are inconclusive or insufficiently supported. *Id.* at p.5 (discussing the Applicant's misguided reliance on Holt and Leasure study in DEIS); *id.* at p. 14 (discussing the "inconclusive" nature of Scheck *et al* study); *id.* at p. 14 (discussing "misleading" quotation to Jackson *et al* study); *id.* at p. 14 (discussing the "inconclusive" nature of Holthuijzen *et al* study); *id.* at p. 15 (discussing how Doresky *et al* study was not comparable to this project, making its use for comparison "inappropriate"); *id.* at p.15 (noting how Stalmaster and Kaiser study actually suggests that explosions be restricted near eagle foraging areas); *id.* at p.15 (discussing lack of scientific reasoning to support Allaire study cited by the Applicant); *id.* at p. 16 (discussing how Reijnen *et al* study does not support the Applicant's assertion that "there should be no effect on wildlife").

The USFWS also casted strong doubts on the DEIS's findings concerning the project's purported lack of impact on the short eared owl (*id.* at pp. 4-5, 12), bald eagles (*id.* at pp. 5, 11-12), the Henslow's Sparrow (*id.* at p.12), the horned lark (*id.* at p.12), or birds generally. In fact, the USFWS cited several studies stating that increases in noise alone negatively affect avian populations. *Id.* at pp. 15-16 (citing Foreman & Alexander, Lohr et al, Dooling & Popper, Barber et al, and Bayne et al studies). Notably, these studies did not consider the added effect of blasting vibrations and/or dust pollution, both of which would be created by the mine.

Other types of wildlife are overlooked or ignored by the DEIS. For example, the DEIS fails to discuss the impact of the project on the Northern long-eared bat, or any other bat species. The failure to address the potential impact on the Northern long-eared bat is particularly troubling considering the species was recently listed as a threatened species in April of 2015. U.S. Fish & Wildlife Service, Endangered Species, "Northern Long-Eared Bat" (*Myotis septentrionalis*) Status: Threatened with 4(d) Rule", http://www.fws.gov/Midwest/endangered/mammals/nleb/index.html. New federal regulations were issued, effective February 16, 2016, which protect bat roosting trees with the designated "White-Nose Syndrome Zone" from purposeful and/or incidental takings during pup-rearing season and at hibernation sites. U.S. Fish & Wildlife "Northern Long-Eared – Final 4(d) Rule" http://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/FAQsFinal4dRuleNLEB.pdf. The proposed project site is in the "White-Nose Syndrome Zone." U.S. Fish & Wildlife Service, "Northern Long-Eared Bat Final 4(d) Rule, White-Nose Syndrome Zone around WNS/Pd Positive Counties/Districts," http://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/WNSZone.pdf. Given the advent of these new regulations, the Applicant should be required to perform testing to determine whether the Northern long-eared bat roosts in the project area to avoid takings and ensure compliance with these new regulations.

Impacts of vibration caused by blasting to wetland and aquatic species were also ignored by the DEIS, despite the presence of those species and habitats being within the so-called AOI and delineated "blasting limit" area. Ex. A at p.4. Shock waves caused by blasting have uniquely harmful effects on fish in that they can rupture swim bladders and stun/disorient fish as the waves move through the water. *Id.*

The effects of noise (with a particular focus on single loud, sharp noise emissions, such as firing ranges) have been studied around the country. The amount of Federal and state noise regulations are increasing as science and knowledge on the subject increases, and surrounding communities absorb the effect of these obtrusive audible functions. Wildlife has been considered in these studies, and the effects of unnaturally loud, random noise events (such as blasting) are negative in a variety of ways.

For example, wild animals depend on sound to hunt and forage, find mates, avoid predators, establish territories and communicate with young. Human activities, particularly military or industrial, have proven to cause negative physiological and behavioral changes in their attempt to adjust to audible increases.

According to the National Bald Eagle Management Guidelines, established by US Fish & Wildlife in May 2007, Category H "Blasting and other loud, intermittent noises" are to be avoided within ½ mile of active Bald Eagle nests (or within 1 mile in open areas). *See* https://www.fws.gov/southdakotafieldoffice/NationalBaldEagleManagementGuidelines.pdf, at p.14. This is because Bald Eagles (and the majority, if not all wildlife) have specific timeframes that life events such as courtship, mating and nesting can happen. Some phases are particularly sensitive, and Eagles will abandon an area if the area is not ideal for their time sensitive purposes. This geographic abandonment could be permanent, as Bald Eagles will return to established roost sites to breed if it is an established 'safe' area, such as a Wildlife Refuge like the INWR, areas that also provides reliable food sources.

Some Bald Eagles may show a higher sensitivity than others, but even individual animals that temporarily remain in disturbed sites have been shown to be negatively affected. Disturbance throws off feeding patterns, which then directly affects nesting mothers and offspring. Energy spent trying to adapt to disruptions increases stress and lowers immunity. "When a human activity agitates or bothers a roosting or foraging Bald Eagle to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior, and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagles Act prohibition against disturbing eagles." National Bald Eagle Management Guidelines, at p. 9.

For the reasons above, further study on the impact of noise on birds and other wildlife within the INWR is required.

Hydrogeology – Increased Surface Water Runoff.

The wetlands are an essential part of the wildlife habitat within the INWR. The Town is concerned about the effect of increased surface water runoff to those wetlands. As quarry development proceeds, the Applicant will have to remove water from the mine to continue extracting the Lockport Dolomite. Water from the mine will be pumped from the mine to a drainage ditch, which drains into the INWR.

More specifically, the discharged mine water will primarily flow into an area of the INWR known as the Schoolhouse Marsh. DEIS Volume 7 at Ex. C. Water levels in the Schoolhouse Marsh are controlled by refuge staff using a water control structure and service spillway to meet habitat objectives for waterbirds. For that reason, controlling the runoff from the mine and into the Schoolhouse Marsh is critical for protecting the wildlife that lives there.

The Applicant admits that there will be a change in the volume of surface water discharge to the INWR, but then completely fails to address what the impact of that increase will be. DEIS Volume 4, Hydrogeologic Analysis at pp. 29-30. Though the Applicant claims that runoff from the mine can be "changed seasonally" to coordinate with the INWR's efforts to control the water level, the Applicant provides no indication of alternative drainage/discharge locations for the mine should existing the runoff to the INWR become problematic. *Id.* Nor does the Applicant indicate that it would stop draining runoff to the mine in the event that problems arose. There is no alternative to runoff into the INWR presented either.

Instead, the Applicant proposes that "[t]he Phase I quarry, at its maximum extent, is a more realistic time period to assess potential surface water impacts" to the INWR. *Id.* at p. 30. In other words, the Applicant suggests that it should only have to address the surface water issue when it is already too late – *i.e.*, when the runoff is negatively impacting the habitat in the Schoolhouse Marsh or elsewhere within the INWR. And deferring that review is, of course, a violation of the segmentation regulations of SEQRA. *See* 6 NYCRR 617.3 ("Considering only a part or segment of an action is contrary to the intent of [SEQRA].").

The USFWS raised concerns about whether INWR staff will be able to adequately manage the water levels in the Schoolhouse Marsh based on the increase in runoff from the quarry. Ex. A at pp. 19-20. USFWS also noted that stable, increased water levels in the wetlands caused by increased runoff from the mine could have a negative impact on the wetlands by facilitating the growth of nuisance wetland plants and provide refugia for nuisance aquatic animals. *Id.* at p. 20.

Since it appears that the effect of this additional water was not fully considered by the DEIS, further study on the potential impact of this runoff to the INWR is warranted.

Hydrology – Drawdown for Wetlands.

With respect to the potential for wetlands drawdown the Applicant concludes that "the [INWR] will not be impacted by ground water drawdown from the quarry." The Applicant basis this conclusion on its "observations that the water levels in the wetlands are associated with the shallow water table, that a thick (30 ft) deposit of underlying, low permeability, silt and clay isolate the wetlands from the bedrock aquifer, and that the water levels in the bedrock are already below the levels in the wetlands." DEIS Volume 4, Hydrogeologic Analysis at p. 29.

The Applicant's basis for this conclusion is unclear. Did the Applicant perform any analysis other than this rudimentary visual observation to support its conclusion regarding the potential for drawdown of water levels in the INWR? If yes, what studies were performed? Does the claimed isolation of the wetlands apply to the entire INWR, or only a certain area? If so, what area(s)?

Answers to these questions are especially important since the Applicant admits that, "drawdown of the piezometric surface (water levels) in the bedrock aquifer have been projected out as far as 7,000 feet from the quarry face, when the quarry is at its maximum vertical and lateral extent." DEIS Volume 4, Hydrogeologic Analysis at p. 29. The maps in the DEIS clearly show that the wetlands in the INWR are within that distance. DEIS Volume 4, at Figure 10 (Regional Land Use Map, Map 3-2). Further, under the DEIS Section 6.0 titled "Adverse Environmental Impacts that Cannot be Voided," the document states that there is the "potential for temporary development of a groundwater cone of depression." DEIS Volume 1, at p. 219. Additional studies of quarry dewatering and impacts on wetlands are clearly needed.

Fred Wurster, a hydrologist with the USFWS, questioned the methods used by the Applicant to approximate wetlands drawdown. In particular, Wurster noted that there were uncertainties associated with the Applicant's chosen method of analyzing quarry drawdown that could produce "very different drawdown impacts" than those predicted in the DEIS, further supporting the need for additional hydrogeologic studies. Ex. A at p. 22.

Wurster also noted that drawdown could negatively affect another unique local natural resource – the Oak Orchard Acid Springs. *Id.* at p.21. The Acid Springs are an area which naturally retains a low pH and high concentrations of dissolved minerals, and therefore supports unique wetland flora and fauna. *Id.* Even though the Acid Springs are located outside projected drawdown of the mine, because the DEIS notes that the mine could fundamentally alter the piezometric surface in this portion of the Lockport Dolomite aquifer, reduced groundwater flow in general could still negatively impact the Acid Springs and the wildlife there. *Id.*

Given the importance of the wetlands to the Refuge and the critical habitat areas those wetlands support, additional study is warranted with respect to the quarry's potential drawdown impact on wetlands, including the potential effect on the Oak Orchard Acid Springs.

Hydrogeology – Wetlands Water Quality.

The Hydrogeologic Analysis in the DEIS estimates that surface water flowing into the INWR from the quarry could reach 1,083.53 gpm, over five times the current rates of 185.33 gpm. DEIS Volume 4, Hydrogeologic Analysis at p. 137. Stormwater and water from quarry dewatering will come into contact with sediment, dust, pollutants (lubricants, petroleum, etc.), and will be discharged into the INWR. As a result, hundreds of thousands of gallons of wastewater will be discharged into refuge wetlands daily. Though some mitigation may be achieved through a Stormwater pollution prevention plan ("SWPPP") and the design in the Mined Use Plan, significant attention must be paid to this impact, since it will directly affect the INWR.

The USFWS noted that, as the depth of a mine increases, the quality of the water decreases. Ex. A at p.20. Water samples collected from wells near the base of the Lockport Dolomite in nearby areas contain natural gas, hydrogen sulfide, and a higher concentration of total dissolved solids than water from shallower areas. *Id.* The DEIS has not accounted for the potential effect that this poor quality water could have on the fragile wetland habitats and aquatic animals in the Schoolhouse Marsh and other areas downstream from where the mine discharge will flow. Further studies should be performed to determine what effect this runoff could have on the INWR wetlands, and what mitigation efforts could be performed to lessen the effects of said runoff if harmful effects were found.

Hydrogeology – USFWS Study

The USFWS conducted a two year study examining potential hydrology issues raised by the proposed mining project. The document titled "Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties NY" concluded:

- The proposed quarry discharge will likely include large volumes of water that will be of substantially lower water quality than the runoff that currently flows through the INWR.
- The unique wetland system within the INWR may be altered.
- Quarry water to be discharged may include poor quality water containing chlorides, "black water", hydrogen sulfide, methane, ferrous sulfide, and trace metals.

- The hydrogeology of the INWR may be altered by dewatering of the mine and lowering of groundwater elevations.

See generally Exhibit E.

The conclusions of the USFWS study confirms many of the fears raised by the Town above, cast doubt on nearly all of the findings of the Applicant with respect to the potential hydrogeologic effects of the mine, and make it clear that further hydrogeologic study is needed before the true hydrogeologic impact of the project can be assessed. The Applicant should therefore be required to address the comments and conclusions in the USFWS study before a mining permit is issued.

B. The DEIS and MLUP Do Not Adequately Address the Potential Impacts of the Mine on the Iroquois Job Corps Center.

The IJCC is an educational training program administered by the U.S. Department of Labor which provides no-cost education and technical training to young persons ages 16 through 24. The IJCC is located roughly 1,300 feet from the proposed mining operation. The center houses 255 students in dormitories, and employees over 100 staff members. The close proximity of the mine to the IJCC raises several potential issues of environmental concern, including:

Impact of Increased Truck Traffic

The mining operation will result in a significant increase of heavy truck traffic around the IJCC. The DEIS states that the mining operation will cause trucks to continuously enter and/or exit the mine site via Sour Springs Road, a local road which is used to access the IJCC. It is estimated that trucks will be taking this path once every 75 seconds. Ex. B, at p.1. The increased truck traffic from the mine creates safety concerns for youth pedestrians and bicyclists living at IJCC, creates excess noise, and lessens air quality, all of which will negatively affect the operation of the IJCC as a whole.

The DEIS does not appear to consider truck traffic and the effect of the accompanying air and noise pollution on the IJCC. *See* Ex. B. Such an increase in commercial truck traffic in an otherwise rural educational setting is a substantial change to the existing environment. The traffic related noise, dust, safety and diesel emissions in the area surrounding the IJCC require further evaluation.

Disruption of Educational Activities from Blasting

The location of the IJCC in a quiet, secluded, and serene environment is crucial to IJCC's educational mission. Even with advanced warning, blasting from the mining operation would be detrimental and disruptive to conducting educational activities at the IJCC. Ex. B at p.2. It is questionable whether mitigation of this disruption is possible considering that blasting will be largely restricted from 9:00a.m. to 4:00p.m. – *i.e.*, during school hours. However, at a minimum, the Applicant should be required to notify the IJCC prior to any blasting activities to avoid disruption to curricular activities.

Structural Impacts to IJCC Buildings

Blasting from the mining operation could also have an impact on the structural integrity of the buildings of the IJCC. The Applicant has not adequately addressed these concerns and should have to do so before its permit application can proceed. At the very least, a pre-blasting survey should be taken of the IJCC so that the effect of the blasting on the IJCC can be measured and assessed as mining operations commence.

Impact on the IJCC's Water Wells

The IJCC relies on 75' depth wells to provide domestic water for the center's students and staff. Development of the quarry and drawdown of these wells could impact the quantity and quality of the well water. Ex. B. More importantly, a municipal water connection is not available to the IJCC, and the DEIS did not investigate or consider an extension from a public water supply. *Id.* The Applicant should be required to investigate alternative water sources for the IJCC should mining operations negatively affect the wells at the center.

C. The DEIS Does Not Adequately Discuss Potential Alternatives to the Current Mining Plan and Fails to Address the Cumulative Impact of the Same.

In consideration of the unique and sensitive environment of the INWR, and the educational institution that is the IJCC, the siting of a large quarry with an operational life of 75 years is far from ideal. The current version of the DEIS is nearly 2,000 pages long and contains numerous supplements. However, the Applicant spends only nine pages discussing "alternatives" to the current proposal. DEIS Volume 1, at p. 221-29.

The only potential changes that are discussed involve relocating access points and/or the processing plant. *Id.* The Applicant's analysis was entirely dismissive of reducing the size of the mine, stating that "many of the potential environmental impacts associated with the project, such as air, noise, and blasting, are not associated with project size." *Id.* at p.225. Other potential effects of reducing the size of the mine are downplayed, "supported" by explanations that are either theoretical and/or entirely without evidentiary support. Pursuant to SEQRA, alternatives to the proposed action need to be considered which would fully avoid any adverse impact to the INWR.

Similarly, Section 7.1 of the DEIS mentions alternative reclamation design in only the most cursory way. The Reclamation Plan will essentially turn the site into two rectangular lakes at the conclusion of the 75 year life of the mine. Presumably these will be utilized for recreation and wildlife. At the end of the 75 year life of the mine, the land will not be available for additional uses. While recreation is important, the site will be lost to uses such as agriculture and residential, which is the current zoning, consistent with the Town's comprehensive plan. The nature of the proposed reclamation would preclude reclamation during the life of the mine. What alternative reclamation options have been considered, and why were they rejected?

The DEIS states that "[a]lternatives in reclamation design which would prepare the site for secondary land use are few." DEIS Volume 1, a p.222. Were any uses considered besides lakes? If so, they should be fully discussed in the DEIS. It appears that alternatives were not fully considered.

In addition, the DEIS states that "[n]o action would result in a failure to economically satisfy the market demand for DOT-specification crushed stone and high-grade agricultural lime and the loss of the attendant economic benefits gained by the community." DEIS Volume 1, at p. 229. The Applicant cites to no studies which support this conclusion. The Town is aware of numerous other mines in the immediate area. If the Applicant insists that there is a need for this project, the Town should be given the opportunity to contest that need. Alternatively, the Applicant should provide the Town with evidence of such need so such evidence can be subject to scrutiny and verification.

The nearly 2,000 page DEIS complete fails to address the potential cumulative impact of the mine on Town and surrounding area, spending all of four sentences in that regard. DEIS Volume 1, at p.193. The Applicant cites to an old version of the SEQR handbook, stating:

> Cumulative impacts are impacts on the environment that result from the incremental or increased impact of an action(s) when the impacts of that action are added to other past, present and reasonably foreseeable future actions. Cumulative impacts can result from a single action or a number of individually mine but collectively significant actions taking place over a period of time. Either the impacts or the actions themselves must be related.

Id. (citing "The SEQR Handbook, 1992"). The Applicant then concludes that since "the action is not part of a larger action(s) it is not interdependent of anything, and the proposed quarry will not incrementally be significant to any related action (*e.g.*, same road segment, hydrologically connected, etc.). For these reasons the proposed project will have no significant cumulative impacts." *Id.*

The Applicant's reasoning in this regard is faulty. The 2010 SEQR handbook does contain the language above. However, it also goes on to state: "Cumulative impacts do not have to all be associated with one sponsor or applicant. They may include indirect or secondary impacts, long term impacts, and synergistic effects." *See* 2010 SEQR Handbook, at p.83, http://www.dec.ny.gov/docs/permits_ej_operations_pdf/seqrhandbook.pdf. Further, "[a]ssessment of potential cumulative impact assessment should be done under the following circumstances: . . . If the impacts of related **or unrelated** actions may be incrementally significant and the impacts themselves are related." *Id.* at p. 84 (emphasis added).

Other mines and quarries exist within the region. Under SEQRA, the cumulative impact of these mines and quarries upon the Town and the INWR must be evaluated. The Applicant cannot simply state that since its project stands alone in the sense that it is the Applicant's only project in the area, the environmental effects of existing industry in and around the Town and INWR would not be affected by the addition of a new mine (be it from increased dust, noise and air pollution, etc.). The DEIS must evaluate these cumulative impacts. Since it does not, it is deficient and must be supplemented.

II. THE DRAFT PERMIT DOES NOT IMPOSE SUFFICIENT RESTRICTIONS ON THE APPLICANT OR THE PROPOSED MINE.

As a second adjudicable issue, the draft permit issued to the Applicant fails to set sufficient conditions on the Applicant. Therefore, the draft permit does not minimize the potential environmental impact of the mine as required by SEQRA. The Town maintains that the following conditions are insufficient:

5. **Distance From Mine to Property Line** No land within 25 feet of any property or right-of- way boundary may be affected by any mining related activity. When mining is conducted below the level of adjacent property, the horizontal distance from the toe of the mine face to the nearest property or right-of-way boundary must be no less than 25 feet plus 1.25 times the depth of excavation.

Issues with condition 5: Condition 5 states that no mining activity shall be conducted within 25 feet of any property or right-of-way boundary. This setback distance may be increased based on the depth of the mine below the level of the adjacent property. Given the many potential adverse impacts to the INWR and wildlife identified in the DEIS, the Town does not believe that this setback is adequate to mitigate such impacts. Notably, the southernmost border of the proposed mine is roughly the northern border of the INWR. To mitigate the environmental effects identified by the DEIS, the draft permit should be modified to increase this setback. Additional studies should be performed to determine the appropriate increase in setback.

6. Dust Control Water or other approved dust palliatives must be applied to haulageways and other parts of the mine, as often as necessary, to prevent visible dust from leaving the mine property.

Issues with condition 6: DEC proposes that the applicant be required to use water or other approved dust palliatives on roads and other parts of the mine to prevent visible dust from leaving the mine property. However, this is another instance where the DEIS does not fully consider the range of impacts which could result from the proposed mining operation. This condition should be modified to require the use of water or other approved dust palliatives on trucks leaving the mine as well. Unlike other sources of dust within the mine boundary, trucks leaving the facility have the ability to cause dust pollution on a far greater scale. Therefore, methods for mitigating or reducing such dust pollution should investigated by the Applicant, and related conditions added to the draft permit.

In addition, NYSDEC routinely requires community air monitoring at construction projects. Given the potential for dust generation through quarry operation (blasting and crushing) and the associated truck traffic, some form of dust monitoring requirement is appropriate. Where dust proves to be a problem, definitive contingency measures to mitigate dust generation should also be considered. Accordingly, a monitoring condition should be inserted into the draft permit, and the Applicant should be required to develop a contingency plan to address the potential need for dust mitigation measures.

> **10. Site Access and Traffic.** Site access (ingress and egress) shall be provided by either of the two following access points and routes:
>
> a. directly via the northern Fletcher Chapel Road entrance shown on the Mining Plan Map with haul traffic traveling to and from NYS Route 63 using Fletcher Chapel Road; or
>
> b. directly via the Sour Springs Road entrance shown on the Mining Plan Map with haul traffic traveling to or from NYS Route 63 on Sour Springs Road and Oak Orchard Ridge Road. Prior to using the Sour Springs Road Entrance for haul traffic, the permittee shall perform road improvements described in the DEIS Appendix 8, Transportation Impact Study, dated June 2007 and revised January 2013, and as may be further directed by the governing transportation agency authorities.

<u>Issues with Condition 10:</u> Condition 10 discusses site access to the mine. The DEIS confirmed that the mine will greatly increase truck traffic along several local roads. However, the DEIS and the draft permit do not adequately consider the effect on these roads.

Therefore, the current condition of these roads should be surveyed by the Applicant. It is anticipated that the increased traffic will result in additional upkeep, maintenance and repair costs. To the extent that these costs and/or damages are due to heavy truck traffic, the DEC should impose some sort of cost-sharing/responsibility on the Applicant for the road damage caused by its operations.

In similar situations, project applicants and municipalities commonly enter into road use agreements which address these very issues and provide the necessary funding to repair and maintain the roads. The draft permit should be modified by requiring the Applicant to negotiate an acceptable road use agreement with the Town.

The Applicant proposes to access the project site through Sour Spring Road, which runs north and south through the INWR. The Applicant evaluated site access by way of Fletcher Chapel Road and concluded that this alternative can "adequately accommodate the projected traffic volumes and resulting impacts to the study area intersection without adverse impacts to traffic operations." DEIS Volume 1, at p. 229.

The draft permit should be modified to require the applicant to use the alternative Fletcher Chapel Road route. The use of this alternative truck route should lessen truck traffic through the INWR. Minimizing or eliminating travel through the INWR has the potential to mitigate noise, air quality, and safety concerns and would maintain the aesthetic, recreational, and educational aspects of the INWR.

Given the substantial increase in truck traffic, a professional baseline road assessment of the proposed truck route is also warranted and should be conducted to identify existing conditions and deficiencies of local infrastructure. Additionally, given the agricultural/rural setting of the project, financial agreements (*i.e.*, issuance of a host community bond) should be established to provide capital for the maintenance of Town roads used by quarry trucks. Periodic road assessments should be conducted to ensure the upkeep of local infrastructure which may be impacted by the projected increase in traffic.

> **11. Residential Well Supply Agreement** Without restricting the right of the Department to take any other alternative action it is authorized by law to take, if, after an initial assessment by the Department, it is suspected that mining operations have impacted the quantity or quality of groundwater at and in the vicinity of the mine site, the Department may direct the permittee to take any or all of the following steps to address the situation:
>
> a. The permittee must immediately supply water at its expense to the impacted property or properties, and must continue to supply water to the impacted property or properties unless and until the permittee can demonstrate to the satisfaction of the Department that the mining operation is not a contributing cause to the identified impacts. In the event that the impacted water supply is utilized as a drinking water source, potable water must be supplied.
>
> b. The permittee shall undertake tests or investigations as deemed necessary by the Department to aid in determining the cause of the identified impacts.
>
> c. If the Department concludes that the mining operation has negatively impacted groundwater at and in the vicinity of the mine site, the permittee must, at its expense, provide an alternate, permanent source of water to the impacted property or properties. In the event that the impacted water supply is utilized as a drinking water source, the permittee must connect any impacted property or properties to a municipal water supply system, if available, or, if a municipal water supply system is unavailable to the impacted property or properties, a permanent potable water source must be supplied.

Issue with Condition 11: Condition 11 of the draft permit requires the Applicant to assist well owners if drawdown from mine dewatering negatively affect the owners' water wells. The DEIS does not appear to indicate whether Town residents are being notified and/or warned of the potential drawdown effect on these wells. The Applicant should be required to hold informational sessions for all potentially affected landowners so that those residents are aware of who to contact should a problem occur. In addition, the draft permit should be modified to require the Applicant to forward any complaints received about the wells to the DEC to insure that said complaints are promptly investigated.

The DEIS does not provide a comprehensive inventory of groundwater wells that may be impacted by the proposed mining activities either. The DEIS states that "seventeen [residential well] surveys were distributed to residences closest to the project. Three [surveys] were returned." DEIS Volume 1, at p. 102. However, Figure 12 of the DEIS shows that there are approximately 65 wells located within the projected drawdown area. Relevant well information (*i.e.*, well depth, well use, availability of a municipal water supply, etc.) pertaining to the majority of wells located within the drawdown area projected by the DEIS remains unknown.

Potential impacts to residential wells resulting from the proposed mine activities are inconsistent with existing data and remain unclear. With regard to potential impacts to residential wells resulting from groundwater drawdown, the DEIS states that "the maximum drawdown will occur along Fletcher Chapel Road, adjacent to the mine, where water levels could decline approximately 40 ft. This should not be considered an impact to these residents, or for any residents along Fletcher Chapel, since a municipal water line extends along Fletcher Chapel Road." DEIS Volume 1, at p. 106.

There is a lack of data pertaining to the groundwater wells located along Fletcher Chapel Road (*e.g.*, well depth, pump intake depth, etc.) to support the conclusion that an approximate 40 foot decline in groundwater levels would not impact any residents along Fletcher

Chapel Road. Existing DEC data on registered wells within the Township indicates that the average well depth of local groundwater wells is approximately 49 feet, suggesting that a 40 foot decline in groundwater levels would potentially impact the quantity of groundwater available to wells located near the proposed mine site.

Additionally, several residences along Fletcher Chapel Road are not connected to a municipal water supply as indicated by Table 11 of the December 19, 2012 Hydrologic Investigation conducted by Alpha Geoscience. The mere presence of a municipal water supply does not mitigate potential groundwater well impacts. The DEIS should evaluate the feasibility and cost of connecting nearby properties, including but not limited to the IJCC, to a municipal water source as a contingency measure to potential groundwater well impacts. Potential impacts to groundwater quality resulting from ground disturbance activities (*e.g.*, blasting, drilling, etc.) should also be investigated and addressed by the DEIS.

Given the critical importance of a reliable and quality water supply to Town residents, additional study and a detailed analysis of contingency measures, if applicable, is warranted with respect to the potential impacts to groundwater quantity and quality associated with proposed mining activities.

In addition, Condition 11 does not mention the potential effect of dewatering the mine on the wells which service the IJCC. This provision should be amended so it applies to all properties in and around the mine, not just residential properties as the title of the condition suggests. As noted above, this is particularly important for the IJCC because it does not have the capability, nor does the infrastructure exist, by which IJCC could connect to the municipal water supply if its wells were affected or rendered inoperable.

> **12. Groundwater Quantity Monitoring** The permittee shall conduct groundwater quantity monitoring in accordance with the monitoring plan contained in Volume 4, Appendix 4 of the January 19, 2014 Draft Environmental Impact Statement at the following well locations: PW-1, DH1-05, DH4-05, barn well, garage well, and the four sets of new monitoring wells at the locations shown on the Mining Plan Map. The four sets of new monitoring wells must be installed, and at a minimum, baseline water elevation data must be collected prior to the initiation of mining.
>
> Groundwater monitoring shall consist of measuring water levels monthly during the first two years of mining and then quarterly thereafter. Annual reports summarizing groundwater data will be submitted to the Department for the first five years of mining and then once every permit term prior to the expiration of the permit, for the life of the project. The permittee will maintain a database of quarterly measurements throughout the life of the mine.

Issues with Condition 12: The DEIS readily admits that dewatering the mine will result in a substantial increase in the amount of runoff to the wetlands within the INWR. This is a very substantial change to an established, very unique natural ecosystem. However, the draft permit does not provide for groundwater monitoring within the INWR. Since the mine directly discharges water into the INWR, the permit should be revised to require the Applicant to monitor water levels within the INWR so that adjustments to the discharge can be made if problems arise (such as if INWR staff have trouble controlling the wetlands levels in Schoolhouse Marsh, or if the discharge starts to negatively affect the wildlife habitats within the INWR).

The draft permit should also require the Applicant to perform regular groundwater quality monitoring within discharge areas of the INWR. Since the mine discharges directly into a unique wetland habitat, it is important for INWR staff to be aware of the potential contaminants within the discharge water so that the effects of the same can be carefully monitored. Since water quality in a mine decreases as mine depth increases, monitoring frequency should be increased as the proposed mine progresses through its various phases.

As a component of the proposed quarry operations, groundwater that accumulates within the quarry will be discharged pursuant to a State Pollutant Discharge Elimination System (SPDES) permit. It appears that SPDES benchmark monitoring is associated with rain events. As it stands, dewatering of the quarry during non-rain events is not subject to analytical monitoring. Consequently, during non-rainfall days of operation, pollutants from operating equipment associated with the proposed mining activity have a potential to commingle with groundwater that will ultimately be discharged to the INWR without analytical monitoring.

Analytical SPDES monitoring should be conducted during non-rainfall days when quarry pump out of groundwater is conducted to more accurately monitor the quality of surface runoff discharged from the project site to the INWR.

14. Alternative Mine Dewatering Discharge Location Upon written request by the United States Fish and Wildlife Service (USFWS), the Permittee shall use the alternative mine dewatering route identified as "drainage basin 2" in the letter dated November 11, 2015 from John Hellert to Scott Sheeley. Use of the alternative discharge location shall:

a. Occur for the full period specified by the USFWS request,

b. Be the minimum seasonally necessary to achieve proper mine dewatering, but at no time exceed a rate of 554,264 gallons per day, and

c. Meet all effluent limits and requirements of the Permittee's coverage under the State Pollutant Discharge Elimination System (SPDES) Multi-Sector Permit

Issues with Condition 14: From the Town's review of the DEIS, it does not appear that the Applicant investigated any alternatives to draining that water into the INWR. The "alternate" discharge route from the draft permit simply channels the mine runoff from one area of the INWR to another. DEIS Volume 7, at Ex. C. However, if the runoff be harmful to the habitats there, it would not make sense to permit the Applicant to simply shift the area of discharge within the INWR – that would simply exacerbate the adverse environmental impact by spreading it to another area of the refuge. Therefore, the Town requests that the Applicant be required to find a suitable alternative mine dewatering discharge location outside of the INWR. The Applicant should also be required to develop a contingency discharge plan in the event a discharge to the INWR must be terminated.

15. Pre-Blast Survey

Prior to engaging in blasting, the permittee shall conduct a pre-blast survey for residential and commercial structures, not owned or leased by the permittee, that are within 1500 feet from the final Life of Mine boundary.

Landowners within 1,500 feet of the Life of Mine boundary shall be notified in writing that they have the right to have a qualified third-party conduct a pre-blast survey prior to any blasting taking place at the quarry. This letter shall describe the procedure for making a pre-blast survey request to the company.

The survey shall document the condition of the dwelling or structure and catalogue preblasting damage and other factors that could reasonably be affected by blasting at the mine site. Assessment of appurtenances, such as pipes, cables, transmission lines and water well systems, shall be limited to surface condition and readily available data.

Copies of the completed pre-blast survey reports will be provided to the person requesting the survey, and to the Department. Survey reports and documentation of all contacted parties (including those that refused pre-blast surveys) shall be maintained by the Department.

Issues with Condition 15: Condition 15 requires the Applicant to conduct pre-blasting surveys of potentially affected buildings. Residents also have the right for a third party evaluation. However, the cost of the same is not addressed in the draft permit. The Town believes that the cost of such studies should be shouldered by the Applicant.

The DEIS asserts that effects of blasting will be negligible on buildings more than 1,700 ft. from the blasting site. Though the Applicant bases this conclusion on its review of literature, it does not appear to have verified this conclusion via independent testing. In addition, the Applicant should be required to conduct a pre-blast survey for the Jobs Corps Center. Though the Jobs Corps Center is beyond the 1,700 foot boundary, the use of the center for educational activities warrants special consideration to ensure the safety of its students.

Some form of outreach is also necessary to warn people within the INWR of a pending blast. Whether it be via notification to INWR staff or the posting of other public notices, these warnings would help minimize the effect of potentially startling blasting noise on recreational activities within the refuge.

> **17. Blasting Hours** Blasting shall be conducted between the hours of 9:00 a.m. to 4:00 p.m. Exceptions to this will require prior written notification by the permittee and prior written approval from the Department. No blasting will occur on weekends or legal holidays.

Issues with Condition 17: This condition should be modified to state that exceptions to the acceptable blasting time periods should may only be sought in cases of emergency. There is no reason why blasting should not be limited to the 9:00am to 4:00pm, Monday to Friday time periods.

In addition, the draft permit does not place any limits on the amount of blasting that can be conducted by the Applicant. Daily or weekly limits on blasting should be added to the draft permit to minimize the potential negative effects on Town residents, local wildlife, nearby buildings, and the INWR.

> **21. Air Blast Limits** Air blast shall not exceed 133 dB at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area.

Issues with Condition 21: Condition 17 of the draft permit currently sets an air blast limit at 133dB outside of any dwelling, public building, school, church, or community or institutional building outside of the permit area. There does not appear to be any evidentiary support, in the DEIS or elsewhere, to support such this level of permissible noise.

Per OSHA, sound limits over 130 dB are louder than that of a jet taking off at 100m. The same resource described sounds at 140 dB as being at the "[t]hreshold of pain." https://www.osha.gov/SLTC/noisehearingconservation/index.html#loud. Per the NYS DEC's Sound Policy, a dB(A) of more than 130 is characterized as "painfully loud," and an equivalent sound source to a "carrier deck jet operation." NYS DEC: Assessing and Mitigating Noise Impacts, DEP-00-1 (Rev. Feb. 2, 2001).

The Town also recommends a monitoring plan to verify the air blast noise limits are achieved and that individual blast noise data be provided to the Town for review by the Town residents and other members of the public.

There is no indication that efforts were taken to mitigate the effect of blasting noise either, other than to constrain it to certain time period. Further study on the noise limit for blasting is clearly required. In addition, sound limits within the Town and INWR as a result of blasting should be reduced to a more reasonable decibel level.

SUMMARY OF ISSUES FOR ADJUDICATION

(1) SEQRA Issues - Deficiencies in the DEIS:

(a) Failure to Mitigate or Consider Impacts to the INWR.

- Failure to address effects on recreation and wildlife;
- Failure to consider effects of increase surface water runoff to the INWR;
- Failure to consider/inadequate consideration of potential drawdown effect on wetlands; and
- Failure to consider the effect of mine dewatering on wetlands and INWR water quality.

(b) Failure to Mitigate or Consider Impacts to the IJCC.

- Failure to consider the effects of increased truck traffic;
- Failure to consider the mine's potential to disrupt educational activities;
- Failure to consider the effect of blasting on the structures and wells at the IJCC; and
- Failure to consider the potential drawdown effect on the IJCC's wells and the lack of an alternative water supply.

(c) Failure to Consider Alternative Designs/Reclamation Plans and/or Cumulative Impact of the Proposed Mine in Conjunction with Other Local Industry.

(2) Insufficient Draft Permit Conditions:

(a) Insufficient setback distance from the border of the wildlife refuge;

(b) Lack of dust control/mitigation measures or plans for addressing dust associated with increased truck traffic from the mine, and a lack of community air monitoring.

(c) Failure to consider the effect of increased truck traffic on local roads. A road agreement should be required, and alternate mine access routes should be investigated to prevent excess truck traffic through the INWR.

(d) The draft permit fails to adequately describe a mitigation plan for local well owners that may be affected by drawdown as a result of the mine. This includes creating contingencies for the IJCC and other well users that might not have access to public water sources.

(e) The draft permit should require groundwater monitoring – both quantity and quality – within the INWR.

(f) The Applicant should be required to investigate alternate mine dewatering discharge basins outside of the INWR.

(g) The draft permit should require the Applicant to fund pre-blast testing for local residents, as well as the IJCC.

(h) The draft permit requires additional limits on blasting, including reduced decibel limits, and limitations on when blasting will be permitted to occur.

CONCLUSION

Petitioner respectfully requests it be granted full party status to adjudicate the above-referenced issues.

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Exhibit A

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Iroquois National Wildlife Refuge
1101 Casey Road
Basom, NY 14013

June 6, 2014

RECEIVED
JUN 11 2014
DEP REGION 8

Scott E. Sheeley
Regional Permit Administrator
New York State Department of Environmental Conservation – Region 8
6274 East Avon-Lima Road
Avon, New York 14414 – 9519

RE: Draft Environmental Impact Statement for a Mined Land Use Plan Mining Permit
Frontier Stone, LLC.
MLR #80823, DEC #8-3436-00033/00001

Dear Mr. Sheeley;

The Iroquois National Wildlife Refuge has reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Frontier Stone, LLC (applicant) quarry located in Orleans County, Town of Shelby just off the Iroquois National Wildlife Refuge (Refuge) boundary. Included below are comments from the Refuge staff for the New York State Department of Conservation (NYS DEC) to consider. Additional comments may be provided by our agency under other legislation such as the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) or the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C.661 *et seq.*).

According to the DEIS, it has been eight years since Frontier Stone has been in contact with the New York Field Office (NYFO) regarding threatened and endangered species. We recommend that the applicant contact the NYFO for an update on these lists as well as candidate species. The Northern long-eared bat is proposed to be listed by the U.S. Fish and Wildlife Service and is known to occur in the area. It does not appear that the DEIS covered this species or other bat species. Additionally, the NYFO can be contacted on any questions concerning bald eagle management.

The effects of noise on Refuge wildlife and visitors have essentially been dismissed as nonexistent by the applicant although their cited references do not support their claims. In fact, a check of the literature quickly shows that many wildlife species are negatively affected by noise associated with machinery and traffic. Most people visit Iroquois NWR (and wildlife refuges in general) to find solitude and silence, whether they are hiking, hunting, observing wildlife, or for any other reasons. There appears to be some disagreement between the applicant and the Refuge on level of disturbance from blasting, operational noise and truck traffic and the impacts to Refuge wildlife and visitors. Example of this is, Sour Spring

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Road and Oak Orchard Road are in the section labeled "Adverse Environmental Impacts That Cannot Be Avoided," however, there is continual mention that there is no impact to visitors or wildlife from traffic on these roads. The NYS DEC, Refuge and applicant should have meeting to discuss these impacts. These and more specific items are listed in Attachment 1.

There remains uncertainty as to the quantity and quality of water that will be pumped from the quarry, particularly as the quarry reaches deeper into the Lockport formation and as it moves through all 4 phases of mining operation. Some of this has not been addressed in the DEIS including impacts during low flow times when 197 gpm are being discharged at a time of year when the Refuge currently only receives very little or no runoff during storm event. In appendix 6 the applicant states that the existing agricultural ditches "do not carry a permanent flow of water." But with the development of the quarry, these areas will now have a permanent flow. Kappell and Jennings' report (2012) indicate that water quality in the Lockport formation will decreases as mining goes deeper, Hydrogen sulfide, natural gas, total dissolved solids and other heavy metals increase deeper into the formation. These issues are not addressed in the DEIS other than to say that hydrogen sulfide will dissipate when aerated. Testing of groundwater quality seems to be based on just two samples, only one of which was taken from a deep well where water quality is most likely the worst. Additionally, water quality is likely to show seasonal variation which cannot be detected with only one sample. There is no indication of requirements for continuously monitoring water quality to ensure the quality and quantity of discharged water. These and other points are discussed more in Attachment 1 and Attachment 2.

The applicant is estimating the water quantity and quality that will be discharged from the quarry and that it will not impact Refuge or State Regulated Wetlands. This quarry will be much deeper than other quarries in the area that the applicant uses for comparison, and thus has a greater chance for higher volume of water to be discharged and as well as decreased water quality. The applicant has not provided sufficient data to ensure their estimates are similar to what will be seen when quarrying operations commence. And they offer no mitigation options if these estimates are incorrect. As mentioned in Attachment 2, a change in approach or hydraulic gradient could have different results. The NYS DEC should not allow water to be discharged off the applicant's property without assurances that water quantity and quality issues have been addressed. Additionally, mitigation plans should be in place prior to proceeding, which include how discharge will be handled if amount of discharge is above the estimated gpm or if water quality issues arise. Mitigation plans are necessary to ensure impacts are avoided to downstream habitats, including areas beyond Schoolhouse Marsh. At this point the applicant is not held accountable for any water that leaves the quarry. This is extremely important due to the fact that there has been no communication with the Refuge staff by Continental Placer, Inc. over water or water management even though there have been multiple letters from the NYS DEC to Continental Placer, Inc. suggesting they discuss water management with the Refuge. This lack of communication leaves us with little confidence that during a time when a water issue may arise, that prompt communications will take place.

The DEIS has had some changes made to it since the last time the Refuge reviewed it, which was about two and half years ago. However, we feel as written it does not address impacts that were brought up previously, including ways to avoid them. Several places in the DEIS indicate that there will be "minimal impact" or "non-significant impact" to the refuge resources or recreational users. Regardless, this shows that there will be a negative impact by quarry operations to Refuge resources and visitors, with no reference to avoid or reduce these impacts on about 300 acres of Refuge land. Other options due exist, however, they are not being considered as an alternative.

We propose the following suggestions/recommendations in addition to comments, questions, and concerns indicated in Attachment 1 and Attachment 2.

1. DEIS needs to discuss quantity of water that will be discharged during low-flow months and the impacts it will have on wetland management as well as management ability of Schoolhouse Marsh and the wetland and habitats beyond Schoolhouse Marsh.
2. Additional deep well sampling needs to be completed to understand quality of water at areas as the mine approaches the base of the Lockport Dolomite. This sampling should also be done on a seasonal basis.
3. Additional information needs to be provided to ascertain whether or not changes will occur in the flow pattern to the Oak Orchard Acid Springs.
4. Information on how the groundwater discharge estimates were developed needs to be stated, to understand why this approach and gradient was used.
5. Applicant should conduct a multi-year study (3-5 years) to determine and record the normal flow rate of water entering the Refuge from the quarry site through the proposed discharge ditch for each day of the year, prior to mining operations. If a permit is granted by NYS DEC, this flow rate will be maintained, based on the day of the year, through constant monitoring and reporting of discharge volume.
6. Applicant should conduct a multi-year study (3-5 years) to determine the normal water temperature and chemistry of water entering the Refuge from the quarry site through the proposed discharge ditch, prior to mining operations. If a permit is granted by NYS DEC, applicant will ensure the same water temperature and chemistry for the life of the project. Additionally, an independent laboratory should collect and test water samples to ensure water quality is maintained.
7. Applicant should conduct additional multi-year study (3-5 years) looking at breeding birds, bird and other wildlife use, and recreational uses on the Refuge that are in the Area of Influence. With protocols set up by the U.S. Fish and Wildlife Service.
8. The NYS DEC, Iroquois National Wildlife Refuge and the applicant need to have a meeting to discuss the disturbance impacts and potential mitigation options.

Keep in mind that any directions that the NYS DEC gives the applicant to conduct further research or surveys where the applicant or designees will be accessing the Iroquois National Wildlife Refuge require permits and authorization from this office to do so. I can be reached at 585.948.5445, ext 2203.

Sincerely,

Thomas P Roster
Refuge Manager

Attachments

Volume 1

Page 14. 1.3.2.7: In this section the applicant states that "short eared owls are known to use quarries for foraging", but provides no basis for this statement.

Page 14. 1.3.2.7: The applicant acknowledges a potential annoyance to wildlife watchers at Schoolhouse Marsh overlook, but then states that "...truck traffic volumes will be minimal when compared to nearby traffic on Route 63...". While this may be true, the Refuge does not have any overlooks on Route 63, so this information is irrelevant to a discussion of potential traffic effects on Refuge visitors at overlooks. What is relevant is that this quarry will introduce disturbance of 60 truck trips per hour to a roadway that currently sees very little traffic volume.

Page 15. 1.3.3.2: The applicant references the map outlining an Area of Influence (AOI) around the quarry for noise and vibration. The limit of vibration detection is based solely on human perception of vibration. There is no mention of the limit of wildlife detection which is likely different than that of humans. Additional research should be included to determine the AOI regarding detection of blasting vibration by wildlife and this information should be included in the wildlife section 1.3.2.7. This should include potential impacts to fish species since shock waves have been known to rupture swim bladders and stun/disorient fish as the waves move through the water. There is no indication in the DEIS that fish or other aquatic animals were looked at, even though the Refuge has several wetlands that have fish species in them either for human recreational use or to provide food resources for birds. One wetland is only a few hundred feet from the quarry and is within the blasting limit shown on Plate 3.

Page 15-16. 1.3.3.2. In the hiking section, the applicant states that there are no hiking trails within the AOI. While this statement is true, during periods of time when the Refuge is open to off-trail hiking, visitors are allowed to hike in areas without designated trails.

In the bird watching section, the applicant states that bird watching activity focuses on migratory waterfowl at the two refuge overlooks on Oak Orchard Ridge Road "outside the AOI" and then concludes that "with the exception of an increase in truck traffic on Oak Orchard Ridge Road, the potential for disturbance to bird watchers is minimal." First, the area along the truck route is clearly within the AOI since it is influenced by truck traffic associated with quarrying operations and it is outlined on the applicants impact map (Plate 3). Second, given the fact that two of the four overlooks on the Refuge are located on this truck route; that bird watchers use Oak Orchard Ridge and Sour Springs roadways and adjacent habitats for birding; and that there will now be approximately 60 truck trips per hour down this road, it is unclear to us how their conclusion of minimal disturbance can be drawn. Third, there is a handicapped accessible deer hunting area just off of Oak Orchard Ridge Road which has not been mentioned. The level of truck traffic as well as other noise from quarrying operations introduces a significant disturbance to an area where there is currently very little noise.

In the hunting section, the applicant states that "impacts to hunting on the nearby Refuge are projected to be non-significant" and that "hunting has not been impacted by numerous quarry settings elsewhere in the region", but offers no supporting information for these statements. Many hunters, particularly bow hunters and turkey hunters, prefer to hunt in a setting with

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minimal noise and disturbance. It seems unlikely that an area near an active quarry would provide the kind of solitude required for this kind of hunting experience. The AOI outlined on the applicant's map (including traffic and vibration) encompasses approximately 300 acres of Refuge property currently open to hunting. For many Refuge visitors, this area will now be unsuitable for hunting due to nearby quarrying operations.

Page 21. 1.5.4.2. The applicant states "Slow progression of mining (i.e. 75 ± years) will allow a gradual relocation of common wildlife species, if any, to a new habitat location." It seems more likely that most, if not all, of the proposed mine area will immediately become unavailable to most wildlife due to the disturbance from mining activities in other sections of the former agricultural fields.

Page 39. 3.1.2.1. This entire document is designed to assess the impacts of this quarry, both positive and negative, over the entire life of the quarry. It is unclear to us what the relevance is that the two regulated wetland ditches will not be affected during the first five years of mining. If they are going to be affected sometime during the life of the mine, they should be part of this analysis. It is our understanding that segmentation of the project review is not acceptable in SEQRA and all wetland impacts need to be addressed prior to project initiation including proposed mitigation.

Page 60-61. 3.1.4.2. The applicant suggests that Center Marsh being periodically dewatered somehow makes it less attractive to bald eagles. All four eagle nests that are currently located within the Tonawanda-Iroquois-Oak Orchard wetland complex are located on impoundments that are periodically dewatered and they continue to nest successfully nearly every year. Dewatering an impoundment helps to regenerate the marsh and it in fact concentrates fish making it easier for eagles to catch prey. In impoundments that have been dewatererd, many eagles (10+) have been seen foraging at one time. Additionally, Center Marsh contains a large and deep borrow ditch adjacent to the dike that nearly always contains open water, even when the rest of the pool is dewatered. Because of this, the applicant's statement that "Center Marsh did not always contain water during our study period" is suspect. Much of the marsh may have been dewatered, but it is highly unlikely that the entire marsh contained no water.

Bald eagles do not require "super canopy" trees for nesting, and the Center Marsh area contains trees that are more than adequate size for use by nesting eagles.

The applicant states that "the nearest open water area of Center Marsh is approximately 1500 feet south of the southern quarry boundary." In fact there is a 3-acre open water area of Center Marsh approximately 350 feet from the quarry boundary, well within the AOI of the quarry. This open water area is clearly marked on the applicants National Wetlands Inventory Map in Appendix 7.

Page 61. 3.1.4.2. The applicant states that based on Holt and Leasure (2008) "short-eared owls are also known to frequent mines and quarries." In fact, that reference states that short-eared owls "may use" gravel pits and rock quarries. The information in Holt and Leasure (2008) is cited from an earlier paper written by R.J. Clark (1975) in which he lists "abandoned limestone quarry partially filled with stumps" and "abandoned gravel pit" as places where he found short-eared owl winter assemblages. Both of these areas are far different than the active stone quarry being proposed and to suggest that this area will somehow be attractive to short-eared owls once quarrying operations commence is inaccurate.

The applicant states that the quarry site was surveyed for short-eared owls on December 13, 2006 and on February 20, 2006 and none were detected. However, the applicant also visited a known winter roost site in the area on two days during winter 2006-2007 and also did not detect any owls, even though, as the applicant points out, it is well documented that owls roosted and foraged in this area during the 2006-2007 winter season. We feel that this shows the level of effort to determine the presence or absence of owls on the quarry site has been inadequate to determine if owls do in fact use this area for roosting or foraging.

Page 62. 3.1.4.2. The fact that horned larks are a "fairly common breeder" in the area is irrelevant. They are still listed as Special Concern by NYSDEC and should be protected as such.

Page 84, 3.2.2. It is unclear how the mere presence of a National Wildlife Refuge meets the number 3 criteria "Cultural, community features and natural resources are minimally or not at all impacted by mining" of most favorable locations for mining? The fact that you have a National Wildlife Refuge, which primary purpose is set up for migratory birds including nesting, would make the area more sensitive to any outside influences like this type of activity.

Page 97. 4.1.2.1. The applicant states that "the area to be disturbed does not represent a major surface water contributor to the Refuge over most of the year." Their proposal to continuously pump 251 gallons per minute of water onto the Refuge represents a significant change in the hydrology of the downstream Refuge areas including continuous flow during time of the year when there would be low or no-flow, as indicated in the DEIS that the drainage ditches do not carry a permanent flow of water. The basis for this conclusion should be more fully explained and mitigation proposed to compensate for potential effects of hydrological disturbance on downstream habitats.

The applicant also states that "after the cessation of mining, a ditch will be cut from the reclamation lakes to the agricultural ditch to free drain the lakes as runoff raises their elevation during precipitation events, restoring existing conditions." In fact existing conditions will not be restored (especially in the fall) due to the water holding capacity of the lakes as a result of summer evaporation. The lakes will need to be filled back up before any water will drain onto the Refuge.

Page 107. 4.1.2.2. The applicant states "the projected groundwater dewatering rate for the quarry at maximum buildout is....about 1.1 million gallons of water per day." Elsewhere in the document the applicant states that they will be continuously pumping 251 gpm of water out of the quarry. This rate equates to 361,440 gallons per day. If 1.1 million gallons of water are entering the quarry each day and they are only pumping out 361,440 gallons per day, the applicant needs to identify what is going to be done with the remaining 738,560 gallons per day whether it is discharged off site or stored onsite.

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Page 112. 4.1.2.2.3 The applicant states that "the nearest wetland is roughly 500± feet from the proposed quarry…." In fact, the nearest mapped wetland (identified in the applicants Wetland Delineation Report) is immediately adjacent to the southeast boundary of the quarry and Refuge wetlands are less than 300 feet from the southern quarry boundary.

Page 119 4.1.2.2.4. The applicant's HydroCAD analysis for storm events stops at a 25-year event. The estimated life of the quarry is 75 years. The storm event analysis should include at least a 75-year event.

Page 124. 4.1.2.2.4. The applicant states that "modeling shows that the existing system has sufficient design capacity to transmit drainage, including storm events, without adverse structural issues." This statement seems to be based solely on analysis from Schoolhouse Marsh. However, the flow of water from the quarry site travels through Schoolhouse Marsh, immediately to another, smaller wetland (schoolhouse Moist Soil Unit). This wetland unit is less than 15 acres and is managed as a moist soil wetland, requiring it to be dewatered nearly every year. This management technique provides habitat for spring migrant shorebirds and fall migrant waterfowl. Occasionally, equipment is used to mow or disc the area. Having a constant flow of water from the quarry entering this wetland would likely make it difficult or impossible to continue this management technique and reduce the amount of quality habitat available for shorebirds and waterfowl on the Refuge. Analysis needs to include the impact of constant flow of water in this area on management of the area and access by necessary equipment, not just that it has the capacity to handle the flow.

Page 124. 4.1.2.2.4. The applicant lists the Schoolhouse Marsh as 74-acre wetland. The NYS DEC State Regulated Freshwater Wetland database indicates that it is 55 acres. LIDAR data for that wetland at full pool indicates that it is about 60 acres. Applicant needs to discuss how they calculated 74 acres, because that can have an influence on the overall impact of the wetlands due to the amount of water that is discharged.

Page 125. 4.1.2.2.4 The applicant states that after completion of mining operations "the project site will contain large ponds/small lakes" and runoff from the area "will exit to the Refuge as it does now." While this runoff may take the same course that it does now, it is unlikely that the volume of water will be the same as it is now. Whenever the ponds/lakes are not full of water, they will accumulate runoff that would otherwise flow into Refuge wetlands. This may be particularly important during storm events in late summer and fall when water levels in the ponds/lakes will be at their lowest. We would like to see an analysis of the seasonal change in water flow after project completion when no pumping is taking place.

Page 131. 4.1.4.2. In this Environmental Impacts section, the applicant mentions horned larks (a State Special Concern species) nesting on the site but says nothing of the impact that the quarry will have on them. Certainly, they will no longer be able to nest on the site where quarry operations are taking place.

Page 132, 4.1.4.2, The applicant indicates "The Refuge's Comprehensive Plan provides guidelines for management of bald eagle populations" and then includes guidelines that are relevant to Iroquois National Wildlife Refuge activities. It would be more appropriate for the applicant to include recommendations for activities that the applicant would be conducting, which are found in "The USFWS National Bald Eagle Management Guidelines of 2007." Additionally, the NYFO can assist on any bald eagle management questions.

Page 133. 4.1.4.3. The applicant states that there will be "no impacts" to the extensions of State wetlands MD-3 and A-5 "from either sedimentation or loss of water." They make no mention of impacts from increased water, water temperature, or pollutants that may be discharged from the quarry. Description and proposed mitigation for these impacts need to be addressed.

Page 170, 4.2.6.3, The applicant indicates that "Placing a perimeter berm along the property line between mine activity and receptors should enable a conservative 10 dB(A) reduction. This results in reducing plant noise, occasional drill noise and excavation area activity by a 10 dB(A) (as the berm acts as a second barrier placed between the highwall and the receptor)." Plate 3 – Proposed Quarry Impacts, Volume 1, shows where mining noise and blasting noise reduces to ambient noise into the Refuge. Mining Plan Map, Sheet 1, Attachment A of the Mined Land Use Plan shows that there is about a 500 foot gap between the berm on Phase 1 and the berm on Phase 2, this is probably due to the National Grid Electric Lines and Sub-station. Since the intrusion noise limit lines on Plate 3 are very similar along the entire Refuge boundary line, did the applicant take the 500 foot of no berm into consideration in developing these noise limits? If not, then this gap in the berm should be addressed as to how far noise will penetrate into the Refuge.

Page 188-193. 4.2.7.1

Hiking: The statement that the area is not conducive to hikers is a values judgment. Different people have different perceptions regarding what is a quality recreation area.

Bird Watching: Refer to comments above regarding Page 15-16. 1.3.3.2. Additionally, the applicant refers to "Marsh Creek" bird watching overlook. There is no such overlook on the Refuge.

Hunting: Refer to comments above regarding Page 15-16. 1.3.3.2.

Page 189. 4.2.7.1. The applicant states that "the Refuge receives nearly half its annual visitation during the months of March and April, which *(is)* outside the normal operating season of the project area." However on page 7 the applicant states that "mining and processing will normally occur from April to November…", showing that in fact the month of April is within the normal operating season.

The applicant states that "Plate 2 illustrates the existing impacts from agricultural activity and traffic; Plates 3 illustrates potential impacts from the proposed action based upon projected calculations for noise and vibrations." These plates are inaccurate and misleading. The legend indicates that the color yellow represents "Refuge area impacted by human activity such as traffic, farming, and residential activity. Projected dBA level of >50." On page 5 of Volume 1, the DEIS indicates "Refuge" to refer to Iroquois National Wildlife Refuge. However, on these plates the yellow markings cover more than just the Iroquois National Wildlife Refuge. A lot of

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the area shaded yellow is along State Wildlife Management Areas as well as private property. Additionally, ambient noise readings are only shown for a couple of areas in the Iroquois National Wildlife Refuge on Plate 2, however, there are many areas surrounding the Refuge that are shaded yellow with no consistency as to how or why they are shaded? There is no indication of how the width of the yellow shaded area protruding into the Refuge was determined, other than the one area where a tractor test was conducted? There are many areas along the Refuge boundary that has no shading even though they have residential areas, where other residential areas are shaded? Also, areas behind residential property are showing the same level of noise (>50 dBA) as road traffic, this appears to be an assumption without taking readings.

Also, the legend and discussion breaks the dBA readings into > 50 dBA or > 60 dBA. They do not mention any maximum level. Greater than 60 does not allow for accurate review of impacts. Actual dBA readings could be in the 70 dBA or 80 dBA, since these are > 60 dBA. NYS DEC Guidance Program Policy, Assessing and Mitigating Noise Impacts indicate that increases of 10 dBA should be considered for avoidance or mitigation, none is proposed for these areas.

Additionally, there needs to be a differentiation between agricultural noise and that of the operation of quarry with continual truck traffic. The discussion indicates that based on projected calculations noise from agricultural practices is more disturbing and reaches farther into the refuge than what quarry operations will because quarry operations will be operating in a pit and there will be earthen berms that will help with noise attenuation. What is not indicated is the duration of the noise. The noise from truck traffic and that of quarry operations could be continual from 6:00 AM to 6:00 PM Monday through Friday and then again from 6:00 AM to Noon on Saturdays from April to November. This would include truck traffic going up and down Sour Spring Road and Oak Orchard Ridge Road up to a maximum of 480 trips per day. This is nowhere near the activity level of agricultural practices. Most farming practices are conducted in probably less than 10 trips per year from plowing to harvest.

The third line on Plate 3 indicates the limit as which one could perceive and vibrations from blasting at the 0.1 inches per second. In a letter from the NYS DEC to Continettal Placer, Inc. on December 9, 2011, the NYS DEC requested that the human perception blasting limits should be assessed at the 0.05 inches per sec. It does not appear that this was done?

Page 193. 4.3. This section on cumulative impacts is critically deficient of information and analysis. It is irrelevant that the project "is not part of a larger action(s)" and that it "is not interdependent of anything." Any potential impacts from "past, present or reasonably foreseeable future actions", regardless of their interdependence, must be evaluated. There are currently two other development proposals in the area that we are aware of that could have potential impacts on the Refuge, local wildlife populations and local recreational opportunities. They include a proposed wind farm and industrial park, both located to the south of the Refuge. Additionally, Refuge wildlife populations are already negatively affected by traffic noise and road strikes and the applicant is proposing an increase in truck traffic adjacent to Refuge habitats. We feel the applicant has not addressed the cumulative impacts of these projects and the impacts of any "foreseeable future actions" along with its own project.

Page 194, 4.4. The applicant states that "If the project site was not farmed, the only alternative would be residential development, which would permanently render a high-quality aggregate unavailable. Farming and residential development are not the only choices. This area could be purchased by Federal, State or non-profit agencies and restored the land to native habitats. In fact, Refuge Manager Thomas Roster actually contacted Mr. Zelazny many years ago to see if he wanted to sell his property to the USFWS.

The applicant states that "It entirely avoids the Iroquois National Wildlife Refuge, as a significant natural resource in the south." Many areas throughout the DEIS indicates that there is minimal impacts to Refuge resources and Refuge visitors. Volume 1, Plate 3 that indicates potential impacts shows vibration range, noise limits, and blasting limits. Additionally, the applicant is recommending that truck traffic to and from the quarry use roads that go through the Refuge and Plate 3 shows significant increase in noise levels. All of these actions are within the boundary of the Refuge, thus we disagree with the statement that the project "entirely avoids" the Iroquois National Wildlife Refuge.

Page 210, 5.1.4.2 The applicant indicates that "Certain impacts on wildlife (e.g. habitat alteration, incidental mortality, increased disturbance) are unavoidable under any site development scenario. The applicant recognizes that sound levels generated by mine activity will extend into the refuge approximately 350 feet. However, they offer no proposed mitigation measures? One proposed measure is to move the southernmost limit of the quarry north 350 feet, thus reducing intrusion into the Refuge.

Page 214, 5.2.3 The applicant's primary traffic mitigation is to route traffic onto Sour Springs Road and Oak Orchard Ridge Road, but they do not address any impacts to wildlife, habitat or recreational use for routing traffic through a National Wildlife Refuge?

Page 217. 5.2.7.1. We feel that the impacts to recreation on the Refuge will be significant, rendering at about 300 acres of Refuge lands unsuitable to many types of recreational activities. Adequate mitigation should be described to compensate for proposed impacts. The applicant indicates that "with the exception of an increase in truck traffic on Oak Orchard Ridge Road, the potential for disturbance to bird watchers is minimal." However, the applicant never addresses the impact from increased truck traffic.

Page 219, 6.0. Adverse Environmental Impacts That Cannot Be Avoided indicates increase in traffic particularly on Sour Springs Road and Oak Orchard Ridge Road. This is contrary to other parts of the document that indicate that there is minimal impact or no impact along these road, however, they are listed here as "Adverse Environmental Impacts That Cannot Be Avoided." If they are adverse impacts, then an assessment of the impacts needs to be completed.

Page 223, 7.2 Alternative Size, Alternative size can have a change in potential impacts with regard to off-site disturbance. The amount of noise that might be taking place during quarry operations would still be the same, but the smaller foot print of the quarry build out can have a difference on areas on the outside perimeter. For example, currently the applicant indicates that noise protrudes into the Refuge by about 350 feet. If the quarry's southernmost area that is

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excavated was moved 350 feet to the north, there is the potential for no additional noise emanating into the Refuge.

Mined Land Use Plan

Page 13. 2.4.2. In Appendix 6, the applicant states that the existing agricultural ditches "do not carry a permanent flow of water." Here they state that water will be pumped into this ditch from the active quarry "to resume the pre-existing condition drainage pattern." We can find no data to support the first statement or any data that identifies the "pre-existing condition drainage pattern." We feel the applicant should record and provide daily water flow data for this ditch prior to quarry initiation to allow a thorough analysis of the proposed quarry's impact to the hydrology of the Refuge. Additionally, we are unclear how the proposed continuous pumping of 251 gpm of water through the ditch and onto the Refuge can be considered resuming the "pre-existing condition drainage pattern" of a ditch that is currently not carrying a permanent flow of water.

Page 4 of the EAF. Question 11. The applicant checked No, yet their own wildlife surveys documented Northern Harrier, a state threatened species, using the site.

Vegetation and Wildlife Study and Ecological Resources Impacts Analysis

Page 4. 1.2.3. The applicant conducted two breeding bird surveys on the Refuge adjacent to the quarry site in 2010. While the timing of the June survey was appropriate, the July survey was likely too late to adequately assess use by breeding birds. An additional breeding bird survey was conducted along Oak Orchard Ridge Road in 2012. This level of survey effort is insufficient to adequately identify the breeding bird resources in this area of the Refuge. Applicant should be required to conduct an additional multi-year study (3-5 years) to adequately document breeding birds.

Page 8. 1.3.4.2. The northern harrier nest search conducted on July 13 would have been at the very end of the harrier breeding season and possibly too late to detect a nest site.

Page 11. 1.3.5.2. The applicant states that "there is little mature forest habitat in the immediate vicinity of the site" as support for their suggestion that bald eagles are likely to not use the area of the Refuge adjacent to the quarry. However, their own bird surveys detected both scarlet tanager and ovenbird, two forest interior species known to prefer mature forests. Additionally, while eagles prefer to nest in large super canopy trees they do not require them and are known to also nest in smaller trees, some as small as 18 inches in diameter. This area of the Refuge contains open water foraging areas and forested habitat, making it suitable for bald eagle nesting and foraging. While it may not be optimum habitat, it is certainly adequate. Also, over the life of the quarry (75+ years), the forest in this area will continue to mature, making it even more attractive eagle nesting habitat.

The applicant suggests that Center Marsh being periodically dewatered somehow makes it less attractive to bald eagles. All four eagle nests that are currently located within the Tonawanda-Iroquois-Oak Orchard wetland complex are located on impoundments that are periodically dewatered and they continue to nest successfully nearly every year. Dewatering an impoundment helps to regenerate the marsh and it in fact concentrates fish making it easier for eagles to catch prey. In impoundments that have been dewatered, many eagles (10+) have been seen foraging at one time. Additionally, Center Marsh contains a large and deep borrow ditch adjacent to the dike that nearly always contains open water, even when the rest of the pool is dewatered. Because of this, the applicant's statement that "Center Marsh did not always contain water during our study period" is suspect. Much of the marsh may have been dewatered, but it is highly unlikely that the entire marsh contained no water.

The applicant states that "the areas of potential future nest locations at Center Marsh are more than 1500 feet south of the southern quarry boundary." In fact there is a 3-acre open water area of Center Marsh bordered by trees approximately 350 feet from the quarry boundary, well within the AOI of the quarry.

Page 12. Short-eared Owl. The applicant states that based on Holt and Leasure (2008) "short-eared owls are also known to frequent mines and quarries." In fact, that reference states that short-eared owls "may use" gravel pits and rock quarries. The information in Holt and Leasure (2008) is cited from an earlier paper written by R.J. Clark (1975) in which he lists "abandoned limestone quarry partially filled with stumps" and "abandoned gravel pit" as places where he found short-eared owl winter assemblages. Both of these areas are far different than the active stone quarry being proposed and to suggest that this area will somehow be attractive to short-eared owls once quarrying operations commence is inaccurate.

The applicant states that the quarry site was surveyed for short-eared owls on December 13, 2006 and on February 20, 2006 and none were detected. However, the applicant also visited a known winter roost site in the area on two days during winter 2006-2007 and also did not detect any owls, even though, as the applicant points out, it is well documented that owls roosted and foraged in this area during the 2006-2007 winter season. We feel that this shows the level of effort to determine the presence or absence of owls on the quarry site has been inadequate to determine if owls do in fact use this area for roosting or foraging.

Page 13. Horned Lark. The fact that horned larks are a "fairly common breeder" in the area is irrelevant. They are still listed as Special Concern by NYSDEC and should be protected as such. Additionally, the applicant's reference for "fairly common breeder" is from 1988. Breeding Bird Survey data indicate an approximately 3.5% annual decline in the horned lark population in New York over the last several decades. Therefore, while they may have been a fairly common breeder in 1988, they are likely a much less common breeder today.

Page 13. Henslow's Sparrow. The applicant states that "the closest nesting area for *(Henslow's sparrow)* is ¾ mile west from the site", suggesting that these birds are nesting too far away from the site to be affected by quarry operations. However, this nesting area is bisected by a small ditch that will transfer any water pumped from the quarry onto the Refuge, making it vulnerable to any water quantity or quality impacts that may occur.

Page 9-13. 1.3.4.3.-1.3.5.2. The applicant has repeatedly stated that there will be "no adverse impact to" various wildlife species", including listed species. However, the applicant's wildlife

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surveys found northern harrier (State Threatened) foraging on the site, and horned lark (Special Concern) and osprey (Special Concern) nesting on the site. Additionally, short-eared owls are known to winter and forage very near the site. On the Refuge, within the AOI, the applicant found osprey and cerulean warbler (Special Concern) on their bird surveys. Other species that have been detected by Refuge staff in this area of the Refuge during breeding or migration season are pied-billed grebe (State Threatened), yellow-breasted chat (Special Concern), and whip-poor-will (Special Concern).

Many species on the Partners In Flight (PIF) list of Species of Continental Importance were detected by the applicant on their bird surveys. On the quarry site they found pine warbler and American tree sparrow. On the Refuge they found eastern-wood pewee, willow flycatcher, wood thrush, blue-winged warbler, chestnut-sided warbler, hooded warbler, and field sparrow.

The applicant also noted that Jefferson complex (blue-spotted and Jefferson) salamanders (Special Concern) as well as box and wood turtles (Special Concern) were detected during the New York State Herp Atlas project within the atlas block around the quarry site. The salamanders are known to occur on the Refuge and spotted and wood turtles are likely to occur there as well. In the applicant's Amphibian and Reptile list (Appendix Table C-1) they label Spotted Turtle as SPEC, but do not identify the wood turtle or either salamander species as SPEC.

The northern long-eared bat is known to occur in this area of New York and is currently proposed for federal listing as an endangered species. Other species of bats known to occur in this area have suffered recent precipitous population declines. We can find no mention of bats or the potential impact on bats anywhere in this document. Given the sensitivity of bats to noise, the proposed listing of the northern long-eared bat, and the population declines of other local bat species, a more thorough investigation of potential effects on bats is warranted.

Given the number of state listed and PIF species found both on the proposed quarry site and on the adjacent Refuge habitats within the AOI and the significant potential for disturbance to these species based on the available literature (see below), we feel that their statements of "no adverse impacts" are inaccurate and unsupported. Statements should be researched, revised and adequate mitigation proposed for unavoidable impacts.

Page 14. 1.4. The applicant states that "no state-regulated wetlands are mapped on or near the site." In fact, State Wetlands A-5 and MD-3 are immediately adjacent to and downstream from the site.

Page 20. 2.3.1. The applicant states "such reduction is not expected to affect the species on a regional level." Cumulative impacts of this project and similar future projects across the range of horned larks are very likely to affect the species on a regional level. The population of this species is already declining, as stated by the applicant, and this is likely the reason the species is listed as Special Concern.

Page 21. 2.3.3. The statement that "development of the proposed quarry site will not cause any adverse impact to short-eared owls" is premature based on the fact that the site was visited only twice in winter and once in summer. As previously mentioned the applicant visited a known roost site twice during the winter and failed to detect short-eared owls even though they were well documented at that same location during that winter.

Page 21-22. 2.3.4. – 2.3.6. In these three sections, the applicant states that "no adverse modification of habitat will occur from the quarry development" referring to bald eagle, Henslow's sparrow, and cerulean warbler habitat. This section of the document is titled "Impacts To Ecological Resources". While the quarry may not result in the physical alteration of habitat for these species, it likely will result in a disturbance to these as well as other species (ecological resources). Any disturbance, not just habitat alteration, on site or on the adjacent Refuge areas, should be identified and addressed in this section of the document.

Page 22. 2.3.7. The applicant states that "the osprey may select another nest location after quarry operations start". Given the fact that the nest is located between the west and east sections of the quarry, north of the southern boundary, it seems very likely that the ospreys may "select another location", clearly indicating an impact to a State listed Special Concern species.

Page 22. 2.4. The applicant suggests that the quarry site could eventually provide 18 acres of wetland habitat. However, there is no plan in the proposal of pursuing this option and therefore it should not be suggested as a proposed mitigation measure.

Pages 25-26. 2.7.2 The literature review of this document is very misleading based on the applicant's conclusions drawn from the literature. We provide the following analysis as the basis for our position.

Schueck *et al.* (2001) provides inconclusive information at best. The authors clearly state "during one period of intensive military training in one breeding season, raptor counts were lower during training than on non-training days." Also, "we observed fewer prey capture attempts on ranges on days with training than on days without training." While some response may vary based on species, training activity type and prey abundance, it is clear that, based on the results of this study, there is a level of bird disturbance associated with military training activities.

The statement that "northern harriers are thought to benefit from military training" based on Jackson et al. (1977) is misleading. This "study" was simply the observations of two people visiting a bombing range for one hour on one day and observing one bird.

Similar to Schueck *et al.* (2001), the results from Holthuijzen *et al.* (1990) are at best inconclusive. The applicant states that "behavior of incubating and brood rearing prairie falcons was not significantly altered." However, the paper's authors state "the overall response rate (i.e., the number of instances in which a change of behavior was observed)..." to blasting "was 54%." It is believed that incubating and brood rearing birds are much less likely to abandon a nesting area than a bird that has not yet laid eggs. The area of the Refuge adjacent to the quarrying operations provides habitat for breeding as well as foraging migratory birds and resident wildlife. A disturbance during any time of year could have a significant negative effect on Refuge wildlife.

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The study of red-cockaded woodpeckers by Doresky *et al.* (2001) is inappropriate for this evaluation because the authors admit that there was no difference in noise levels between their treatment and control areas. Therefore, they were measuring effects of noise disturbance in an area where there was no increased noise disturbance.

The applicant states that "Stalmaster and Kaiser (1997) showed that wintering bald eagles became habituated to helicopters..." However, the last sentence of these author's abstract states "our data suggest that ordinance explosions, low-level helicopter overflights, and boating should be restricted near eagle foraging areas."

The applicant cites Allaire (1978) as recommending "a minimum of 100-meter buffer from mining operations, and where ground nesting birds occur, a buffer of more than 100 meters." While the author does recommend those distances, he provides no reasoning for that recommendation. In fact all of the bird surveys conducted in the research were within a 100-meter wide strip adjacent to the active mine and no surveys were conducted farther away to determine how far the effect of quarrying might occur. Additionally, the bird surveys were conducted on the other side of a ridge separating the forest being surveyed and the mine. One of the main findings of this study was a 39% decline in singing males during quarrying operations.

Several past and recent research studies related to noise, or summaries of other noise-related studies, have identified negative impacts to birds and other wildlife due to noise disturbance. A recent summary titled "The Effects of Noise on Wildlife" available at http://www.fws.gov/windenergy/docs/noise.pdf found the following (quotes below are taken from this summary and citations are available in the References section of the summary):

In there synthesis, Foreman and Alexander (1998) found that "declines in densities of woodland and grassland bird species have been shown to occur at noise thresholds between 45 and 48 dB, respectively; while the most sensitive woodland and grassland species showed declines between 35 and 43 dB, respectively. Songbirds specifically appear to be sensitive to very low sound levels equivalent to those in a library reading room (~30 dBA)."

Lohr et al. (2003) found that "several studies have documented that traffic noise can have significant negative impacts on bird behavior, communication, and ultimately on avian health and survival."

In Dooling and Popper (2007), the authors reviewed papers that looked at "the effect of ambient noise on communication distance and an animal's ability to detect calls. For effects to birds, this can mean 1) behavioral and/or physiological effects, 2) damage to hearing from acoustic over-exposure, and 3) masking of communication signals and other biologically relevant sounds (Dooling and Popper 2007). Of the 49 bird species whose behavioral audibility curves and/or physiological recordings have been determined, Dooling and Popper (2007) developed a conceptual model for estimating the masking effects of noise on birds. Based on the distance between birds and the spectrum level, bird communication was predicted to be "at risk" (e.g., at ~ 755 ft distance where noise was 20 dB), "difficult" (.e.g., at ~755 ft where noise was 25 dB) and "impossible" (e.g., at ~755 ft where noise was 30 dB)."

Barber et al. (2010) reviewed several studies and "assessed the threats of chronic noise exposure, focusing on grouse communication calls, urban bird calls, and other songbird communications. They determined that while some birds were able to shift their vocalizations to reduce the masking effects of noise, when shifts did not occur or were insignificant, masking could prove detrimental to the health and survival of wildlife (Barber et al. 2010)." In this same paper, modeling showed that "with a noise increase of just 3 dB – a noise level identified as "just perceptible to humans" – this increase corresponded to a 50% loss of listening area for wildlife (Barber et al. 2010). Other data suggest noise increases of 3 dB to 10 dB correspond to 30% to 90% reductions in alerting distances for wildlife, respectively (Barber et al. 2010)."

In their research, "Bayne et al. (2008) found that areas near noiseless energy facilities had a total passerine density 1.5 times greater than areas near noise-producing energy facilities." Similarly, "Francis et al. (2009) showed that noise alone reduced nesting species richness and led to a different composition of avian communities."

These and other studies provide significant evidence that noise, even low level noise, can have a significant negative impact on wildlife. The applicant has offered up no mitigation options to reduce the impact to Refuge wildlife.

Page 27. 2.7.3. The applicant provides no basis for the statement that blasting vibrations will be "an insignificant impact" to the Refuge.

Page 27. 2.8. The Reijnen *et al.* (1995) study that the applicant uses to base their assertion that "there should be no effect on wildlife" is not supported by the reference. This study was conducted in deciduous and coniferous forests only. More than half of the area immediately adjacent to Sour Springs and Oak Orchard Ridge Roads is shrubland and grassland, with the remainder in forest cover, so the habitat types are not necessarily comparable. The cited study only looked at roads with between 10,000 and 60,000 vehicles per day. The applicant states that "based on this study, the proposed increase in traffic volumes…would not cause significant noise disturbance to breeding birds." However, the authors of the cited study make no inferences about the affects of traffic on breeding birds along roads with lower traffic volumes. The applicant simply makes this assumption. It seems to us that the overall traffic volume is less relevant than what the increase in volume and noise level will be. The applicant has stated that these roads (Sour Springs and Oak Orchard Ridge) currently receive very low traffic volume. An increase in volume, especially 60 trips per hour by large trucks, may very well have a significant effect on area wildlife.

The applicant provides a comparison in the traffic volume on Sour Springs and Oak Orchard Ridge Roads to the volume on Route 63, to suggest that effects of traffic on wildlife will be minimal. However, the level of traffic on Route 63 is irrelevant to this analysis except to note that the Refuge is already negatively impacted by traffic and any increase in traffic, no matter how small, will likely compound the problem.

The applicants statement that "it appears that traffic has had no notable impact despite the fact that Route 63 bisects the Refuge" is unsupported. To our knowledge, there have been no studies to determine this impact.

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Page 29. 2.10. While referring to the potential for disturbance from truck traffic, the applicant *states* "the threshold for disturbance has been established by the current road traffic and since volumes will not increase significantly, there should be no effects on wildlife." Adding 60 truck trips per hour to Oak Orchard Ridge Road, when it currently has so little traffic that the applicant's own traffic study did not even survey it, would certainly be a significant increase in traffic and has the potential to cause a significant disturbance to wildlife.

Wetland Impact Assessment

The flow analysis conducted by the applicant seems to assume no obstruction to the flow of water through the wetland areas. In fact most of the flow areas are vegetated and this vegetation is dependent on historical flow regimes. Any change to these regimes may have negative impacts to the vegetative community. Additionally, flow analysis that doesn't take into consideration the existing vegetative obstructions will likely overestimate the ability of the system to pass increased water flows.

We can find no discussion regarding the water temperature of water pumped from the quarry onto the Refuge and how that temperature may affect Refuge vegetation and fish and wildlife. Information should be provided that discusses the water temperature leaving the quarry will be and how this temperature may or may not impact aquatic organisms.

Groundwater Assessment

Many references are made to the idea that previously mined areas (e.g., Phase 1) "can" be used to store water before discharging onto the Refuge, but there is no plan outlined for this strategy. Additionally, the water stored in these area will eventually have to be discharged, which may eventually result in an increased average flow (>251 gpm) during later phases of the mining operation. We would like to see detailed analysis of how this storage and later pumping will occur.

Stormwater Pollution Prevention Plan

The Monitoring section of this plan is extremely deficient in monitoring requirements given the sensitivities of downstream areas including a NYS DEC Class 1 wetland. Quarterly visual assessment at one location on the quarry as well as one annual water sample at one location will do little to protect downstream areas if pollutants are being discharged from the quarry.

The Refuge Manager should be included on the Spill Response Plan Emergency Contacts list on page 27. Additionally, in the event of a spill, all pumping of water should be suspended until the spill has been cleaned up and NYSDEC has inspected the area.

Clarification is needed as part of the sampling procedure. The plan calls for sampling to be conducted at Outfall 001, which is where water is discharged into the drainage ditch that will leave the property, after it has been through three proposed settling ponds. However, the procedures indicated at "If the sampled discharge commingles with process or non-process water, the permittee must attempt to sample the stormwater discharge before it mixes with the

Attachment 2: Comments: Draft Environmental Impact Statement for proposed Frontier Stone Quarry near Iroquois NWR
6/3/14 Fred Wurster, Hydrologist

It is clear from the DEIS that the applicants propose to discharge water used to dewater the mine onto the refuge. Water pumped from the mine will flow through the drainage ditch on the property directly into Schoolhouse Marsh, a managed wetland impoundment on the refuge. Water from Schoolhouse Marsh flows into another managed impoundment before entering Oak Orchard Creek, approximately 1 mile downstream from the Schoolhouse Marsh Dike. There are 3 primary water concerns associated with the proposed quarry that are addressed below:

1) The proposed quarry will introduce additional water to the refuge wetlands, altering their hydrology and complicating wetland habitat management.

2) The proposed quarry might introduce poor quality water to refuge wetlands, which will compromise aquatic and wetland habitat on the refuge.

3) Aquifer drawdown due to the quarry may negatively affect groundwater discharge at the Oak Orchard Acid Springs.

1) Hydrologic Impacts of the Proposed Quarry on Refuge Wetlands

As quarry development proceeds the applicant will need to remove water from the deepening quarry pit in order to mine the Lockport Dolomite. Water in the mine is a combination of direct precipitation and groundwater flowing into the pit from the surrounding aquifer. Under the current proposal, water will be pumped from the mine into an existing drainage ditch. Water travels in the ditch approximately 1500 ft before crossing into Iroquois NWR and flowing into the wetland impoundment known as Schoolhouse Marsh. Our primary concern is understanding how the quarry will change the magnitude and timing of runoff into Schoolhouse Marsh. The applicant has estimated the volume of water that will be pumped from the mine using the water budget approach outlined in Volume 4 of the DEIS. In general the applicant finds the quarry will increase the volume of water flowing to Schoolhouse Marsh. The projected increase in runoff is identified in several locations throughout Volume 1 and 4 of the DEIS. The amount of the increase varies seasonally and depends on how much of the mine is completed. The average annual maximum pumping rate from the quarry is estimated to be 988 gallons per minute (gpm) (Volume 4 DEIS, Alpha Geosciences Hydrogeologic Analysis p.15) at full build out. The minimum increase in runoff is approximately 197 gpm (Volume 4 DEIS, Alpha Geosciences Hydrogeologic Analysis p.25) in September when only Phase 1 is completed.

The Schoolhouse Marsh impoundment functions like a small, shallow, reservoir. Water levels in the impoundment are controlled by a water control structure and a service spillway. Refuge staff manipulates water levels in the impoundment to meet habitat objectives for waterbirds. Sometimes water levels are kept high to maximize the amount of standing water in the impoundment. Sometimes water levels are kept low to increase the acreage of mudflats for migrating shorebirds or promote the growth of emergent vegetation, which can be a food source for migratory waterbirds. At its maximum water level, the Schoolhouse Marsh impoundment floods approximately 60 acres inside the area identified as Basin 1 of the DEIS (p. 120, Volume 1).

If the quarry increases surface water runoff to Schoolhouse Marsh appreciably, it could have a negative impact on wetland habitat conditions in the marsh and will compromise the refuge's ability to manage the wetland for migratory waterbirds. In the spring, and following large precipitation events, the additional water from the quarry might be small relative to the volume of snowmelt or storm runoff. However, in the summer months and during extended dry periods the water pumped from the quarry will make up a much larger percentage of the inflows to this portion of the refuge. Because the soils of the area are very fine grained and there is a relatively short distance from the quarry discharge to the refuge boundary (about 1,500 ft), we anticipate very little of the pumped water will infiltrate into the subsurface after it leaves the quarry. Therefore, almost all of the quarry discharge will reach the refuge and, during particularly dry periods, could be as much as 100% of the surface water inflows to Schoolhouse Marsh.

The timing and distribution of quarry discharge to the refuge are very different from the episodic nature of precipitation driven runoff that currently enters Schoolhouse Marsh from its surrounding watershed. The quarry will need to pump continuously to keep up with seepage into the quarry pit from the surrounding aquifer. This will ensure a steady supply of water will enter the refuge year-round. At the lowest quarry discharge estimates of 197 gpm, approximately 2,000,000 gallons will be discharged from the quarry towards Schoolhouse Marsh in a week. A month of steady discharge at 197 gpm will deliver 8,500,000 gallons or 26 acre-feet. During dry conditions the Schoolhouse Marsh impoundment is typically not full. When the impoundment's water surface is at elevation 622 ft, standing water covers approximately 20 acres at an average depth of 1.2 ft. At this level, the impoundment stores approximately 24 acre-feet or 7,820,000 gallons. Even at the lowest estimated discharge rates, the cumulative volume of water entering the refuge is large relative to the volume of water stored in the impoundment during the summer months. The additional water from the quarry will stabilize water level conditions in the impoundment which could have a negative impact on the wetland. Stable water levels are not always desirable in managed wetlands like Schoolhouse Marsh because they promote the growth of nuisance wetland plants and provide refugia for nuisance aquatic animals. Problems will be further exacerbated if the quality of quarry discharge is low.

2) *Concerns over Water Quality of Quarry Discharge*

The results of water quality analyses presented in Appendix G of Volume 4, do not reflect particularly poor water quality. However, the results of one round of sampling from groundwater monitoring wells may not be representative of the quality of quarry discharge once mining is taking place. Of particular concern is the quality of dewatering water as the mine approaches the base of the Lockport Dolomite. Data presented in Kappell and Jennings' report (2012) make a compelling argument that the quality of quarry discharge will decrease as the mine deepens. Water samples collected from wells completed near the base of the Lockport Dolomite and in the vicinity of the proposed quarry have lower quality water than shallower wells. Natural gas and hydrogen sulfide are present in the deeper wells and the concentration of total dissolved solids is much higher than in water from shallower wells (see Tables 1-1 – 1-5, Kappell and Jennings 2012, p.26-31). If the quality of the water in the quarry discharge reflects the quality of water samples from Kappell and Jennings' lower Lockport Wells (wells GS 286, OL 37, OL 42), the poorer quality water may have negative impacts on wetland habitat and aquatic animals in Schoolhouse Marsh and points downstream.

3) *Potential Impacts of the Frontier Stone Quarry on Oak Orchard Acid Springs*

Attachment 2: Comments: Draft Environmental Impact Statement for proposed Frontier Stone Quarry near Iroquois NWR
6/3/14 Fred Wurster, Hydrologist

The Service has expressed concern that the proposed quarry and the associated drawdown in the Lockport Dolomite aquifer may negatively affect the Oak Orchard Acid Springs. The low pH and high concentrations of dissolved minerals in the springs' water support unique wetland flora and fauna.

The applicant discusses the potential impacts of the proposed mine on the springs on pages 20-22 of the Alpha Geosciences hydrogeological report (Volume 4 of DEIS). The applicant claims there will be no impact to the springs because the projected worst-case scenario drawdown does not reach the groundwater discharge zone near Oak Orchard Creek, where the springs are located. We think it's important to point out that the projected drawdown from the mine does not have to intercept the springs in order for there to be a negative impact on spring discharge. Plate 4 of the Alpha Geosciences report indicates that the mine has the potential to fundamentally alter the piezometric surface in this portion of the Lockport Dolomite aquifer. Changes in the piezometric surface will alter groundwater flow paths within the aquifer and the mine will probably capture some percentage of the groundwater that currently discharges at the springs. If enough discharge is captured, the flow from the springs will be reduced and the extent of unique habitat associated with the springs may decrease. The available information is not adequate to estimate the percent change in discharge from the springs due to mine construction.

Other Concerns:

Approach for estimating drawdown within the Lockport Dolomite Aquifer

The applicant outlines the approach for estimating the extent of drawdown due to the mine in section 3.2.2 of the Alpha Geosciences Hydrogeological Report (Volume 4 of DEIS). The results of this approach are presented on Plates 2 and 4 of the Alpha Geosciences report. The authors point out that the estimated drawdown represents a worse-case scenario because the proposed mine will proceed in phases and the entire mine footprint will not be dewatered at a given time. Understanding the approach Alpha Geosciences used to define the extent of drawdown in the aquifer is important because the subsequent water budget analyses and estimates of groundwater discharge to the quarry are based on the areal extent of drawdown (see Section 3.3.2.2 of the Alpha Geosciences Hydrogeologic Analysis). We are interested in understanding how the groundwater discharge estimates were developed because these values are used to estimate the amount of additional water that will be discharged to the refuge once mine dewatering begins.

From the Alpha Geosciences report, it appears that the authors have estimated drawdown using empirical data from previously published documents. Specifically, the estimated slope of the groundwater drawdown around the proposed Frontier Stone Quarry is assumed to be 0.017 ft/ft near the quarry wall which is the same as the drawdown observed by Johnston (1964) near another Lockport Dolomite quarry. The applicant justifies choosing this value because it is between the gradient identified by Miller and Kappel (1987) in the vicinity of the Niagara Power Project and the gradient observed during the pump test for this project. We wonder why the 0.017 value is more appropriate than the 0.053 value and question the appropriateness of the comparison with the pump test drawdown. It seems that drawdown due to a 125 gpm pump test in a single well will be very different from drawdown that occurs when the aquifer's bedding planes are exposed along the face of a quarry wall. In addition to the uncertainties associated with the selection of a drawdown gradient, questions remain about how the applicant quantifies the extent of drawdown. On page 10 of the Alpha Geosciences Hydrogeologic Analysis the applicant indicates the slope of drawdown becomes "flatter" at greater distances from the quarry but does describe how the transition from the "steeper" to "flatter" drawdown gradients is handled.

The uncertainty around this approach is important because it affects the predictions of how much water needs to be pumped from the quarry for dewatering and the potential impact to Oak Orchard Acid Springs. A completely different approach, or the choice of different hydraulic gradients, may produce very different drawdown impacts than what is presented in Plate 4. When trying to evaluate the drawdown impact of the proposed quarry perhaps it is more useful to take a more conceptual approach and compare what is known about the proposal with other quarries nearby. Kappel and Jennings (2012) address this on page 17 of their report by pointing out that drawdown around a quarry can vary depending on the quarry's position in the aquifer. A quarry near the aquifer's recharge zones will draw the aquifer down less than one located at lower elevations, where groundwater in the aquifer is flowing towards the quarry. According to Kappel and Jennings (2012) the proposed quarry is positioned at a lower elevation within the Lockport Dolomite aquifer than other quarries nearby. Therefore, drawdown in the aquifer is likely to be more extensive than drawdown observed adjacent to those other quarries. Additionally, the volume of water flowing into the quarry will likely be greater than what is removed from the existing quarries. Kappel and Jennings (2012) report existing quarry discharge rates between "several hundred" and "several thousand" gallons per minute which is much greater than the estimates provided by the applicant.

Exhibit B

U.S. Department of Labor

Employment and Training Administration
200 Constitution Avenue, N.W.
Washington, D.C. 20210

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DEP REGION 8

JUN - 2 2014

Mr. Scott E. Sheeley
NYSDEC – Region 8 Office
6274 Avon-Lima Road
Avon, New York 14414-9519

Dear Mr. Sheeley:

Subject: *Frontier Stone, LLC's Application for a Mining Permit*
Department of Environmental Conservation (DEC)
File Nos. 8-3436-00033/00001; 8-3436-000033/00002

The purpose of this letter is to provide observations and comments on the Draft Environmental Impact Statement (DEIS) for a Mine Land Use Plan Mining Permit (January 27, 2014). This DEIS, prepared in accordance with the New York State Environmental Review Act and its implementing regulations, addresses the impacts of the proposed development of a stone and agricultural lime quarry on a parcel approximately 3,000 feet north of the Iroquois Job Corps Center (IJCC) (See Attachment 1).

Attachment 2 to this letter provides comments on this DEIS. These comments are grouped according to factors affecting the environmental impact assessment process, the Iroquois Job Corps Center, or key affected resources (air, groundwater, and noise/traffic). These comments support the U. S. Department of Labor's (DOL's) concern that Frontier did not fully evaluate the environmental impacts of all resources over the life of the quarry on the community, including the IJCC. The remainder of this letter clarifies the DOL's concerns with respect to the IJCC.

The proposed quarry is directly adjacent to the Iroquois National Wildlife Refuge (INWR) and the IJCC. Located within the INWR is the IJCC, which is a federally funded education and career technical training program, administered by the DOL. The IJCC assists young adults, ages 16 through 24, to improve the quality of their lives through a residential career technical and academic training facility.

As noted above, the IJCC is located only approximately 3,000 feet from the proposed mining operation. In accordance with the Job Corps mission, the IJCC houses up to 255 students in dormitories located near the proposed quarry and employs approximately 110 staff members. The proximity of student housing, education, and recreation is so close to the proposed quarry presents significant adverse environmental and student safety impacts of concern. First, with respect to traffic, there will be a significant increase of heavy truck traffic as the result of the mining operation. As stated in the DEIS, which was accepted by the New York State Department of Environmental Conservation (NYSDEC) for public review, the proposed mining site will be accessed by Sour Springs Road, a local road. The main entrance to the IJCC is in close proximity to Sour Springs Road, and the local roads have been available for pedestrian use. The DEIS indicates that there will be almost ongoing truck traffic entering and exiting the site, with trucks entering and/or exiting the site onto Sour Springs Road every 75 seconds. The increased truck traffic resulting from the mining operation creates safety concerns for the youth living at the IJCC, and the noise and air quality impacts from the additional truck traffic will adversely impact the IJCC.

Blasting, including the resulting adverse impacts from noise and dust, is another aspect of the application that may adversely impact the IJCC over the long term. Operation of the mine and blasting will proceed during the student training day, which occurs from 8:00 a.m. to 4:00 p.m. The blasting operations are also likely to impact the INWR areas closest to the IJCC. This is a particularized impact to the IJCC, which has not been adequately addressed by the DEIS. For example, the DEIS identifies an "area of influence" where the applicant has concluded that the majority of the impacts to the INWR will occur. If this "area of influence" is even close to accurate, the INWR areas near the IJCC will be impacted at an even greater level. The location of the IJCC in a quiet, secluded, and serene environment is crucial to the IJCC's and DOL's mission. A mining operation will be disruptive. Moreover, the blasting impacts to the integrity of the IJCC's buildings, structures, and overall campus have not been adequately studied or evaluated in the DEIS.

As was noted in the DEIS, the quarry will include a significant dewatering operation, which will lower the water table. The drawdown area as identified in the DEIS is likely to be a 7,000 foot radius. The IJCC's groundwater wells are located within this radius, and any reduction in the groundwater table will adversely affect the quality and quantity of groundwater available to the students. The IJCC utilizes approximately 36,000-40,000 gallons per day of potable water from ground sources. There is no practical way to connect to a public water source, as was noted as a possibility for other affected wells, and the mitigation plan proposed for regular wells appears inadequate. Disruption of potable water availability would result in the imposition of significant costs and the many students residing at the IJCC would have to be relocated.

In addition to the traffic, blasting, noise, dust, and groundwater impacts, student safety is another significant concern. As noted above, up to 255 young students reside at the dormitory facilities in the INWR area adjacent to the proposed mining site. The location of a heavy industrial use this close to student housing is a safety hazard. An open pit will be created as part of the mining operation, there will be heavy machinery operating, and there will be excess commercial traffic.

Another adverse impact to the INWR and the IJCC is the significant quarry discharge that will enter the INWR. Storm water and water from quarry dewatering will come into contact with sediment, dust, machinery, product, and pollutants and will be discharged into the INWR. A conservative estimate is that 500,000 gallons per day of waste water will be discharged into the INWR. This is a significant impact to the quality of life for IJCC students and staff members.

The wetlands in the INWR are an essential part of wildlife habitat and are an important part of the students' environment. The IJCC has significant concerns as to the effect of the quarry's dewatering and quarry discharges on the wetlands in the INWR. The DEIS comes to the conclusion that there will be no impact to wetlands or water bodies from the quarry development. This conclusion is based upon observations of the water levels in the wetlands and a discussion of the soil layer. It is unclear how this conclusion was reached, the analysis that was done to substantiate it, and whether this analysis applies to all wetlands or merely a portion. Additional

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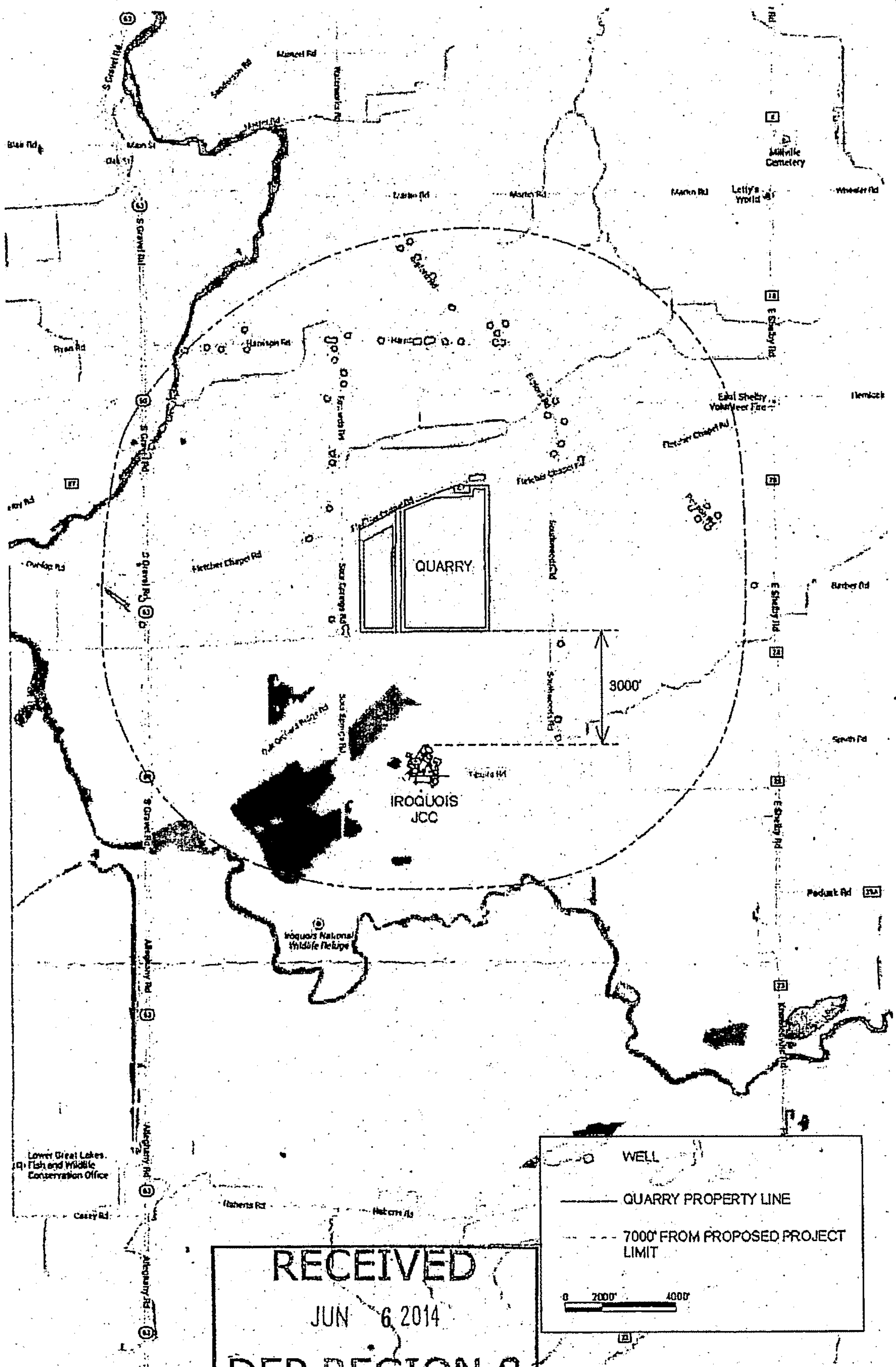
study and information is critical. From the information provided in the DEIS thus far, dewatering and quarry discharge has the potential to significantly impact the INWR's wetlands, which would negatively affect the quality of life of the IJCC's students.

We request that an environmental and safety impact study to the IJCC by the proposed quarry be undertaken. Our concern is that the development of a quarry on property directly abutting a wildlife refuge and within feet of a student housing and educational center presents significant adverse impacts that are unlikely to be adequately mitigated.

Sincerely,

Robert W. Pitulej
Acting National Director
Office of Job Corps

ATTACHMENT 1. SITE LOCATION RELATIVE TO THE IROQUOIS JOB CORPS CENTER



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ATTACHMENT 2. TECHNICAL REVIEW COMMENTS
ON
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR A MINED LAND USED PLAN MINING PERMIT (JANUARY 27, 2014)

The following observations are provided based on a high level review of this document. Time constraints limited the extent to which the U.S. Department of Labor (DOL) could complete a more detailed review. The comments are grouped according to environmental impact assessment process, the Iroquois Job Corps Center, or affected resources.

These comments support the DOL's concern that Frontier did not fully evaluate the environmental impacts of all resources over the life of the quarry on the community, including the Iroquois Job Corps Center (IJCC).

1.0 EIS ASSESSMENT PROCESS

Several deficiencies and flaws with this document are noted below with respect to the EIS framework and content. These observations are based on review of New York Department of Environmental Conservation's requirements for an EIS, which are documented in the New York State Environmental Quality Review Act and its implementing regulations (6 NYCRR Part 617 b).

1.1 Alternatives

For this 1,900 page document, only eight pages are devoted to alternatives (Section 7.0 of Volume I). For each of the seven alternatives, a typical EIS addresses each of the resources affected by the proposed action. Only a cursory analysis was provided, and based on this information, a reviewer cannot determine if the impacts are more or less adverse to the proposed action. Under the no action alternative, the proposed activity would not take place, and the resulting environmental effects from taking no action should be compared with the effects of permitting the proposed activity or an alternative activity to go forward. For the no action alternative, therefore, existing conditions must be thoroughly documented to provide a basis for a comparative analysis to other alternatives.

6 NYCRR Part 617 b (5) indicates that *"The description and evaluation of each alternative should be at a level of detail sufficient to permit a comparative assessment of the alternatives discussed."* This EIS does not rigorously explore and objectively evaluate the no action alternative or the other alternatives summarized. As a result, this document is deficient since a comparative analysis is not possible.

1.2 Affected Environment (Current Conditions)

The current condition (environmental setting) is used as the benchmark for comparing the environmental effects of the alternatives. However, the current condition typically may not adequately represent how actions have impacted resources in the past and present or how resources might respond to future impacts. Designating existing environmental conditions as a benchmark may focus the environmental impact assessment too narrowly, overlooking

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cumulative impacts of past and present actions, or limiting assessment to the proposed action and future actions.

In the case of this site, the land historically was used for farming. This document does not characterize the soil, surface water, or groundwater conditions to reflect the likely use of pesticides, herbicides, or other chemicals. This is a significant benchmark, and with the disturbance of this site, there is likely to be mobilization of contaminants which could affect residents and the surrounding community.

Different methods of depicting the environmental condition are acceptable. The condition of the environment should, however, address one or more of the following:

1) How the affected environment functions naturally and whether it has been significantly degraded;
2) The specific characteristics of the affected environment and the extent of change, if any, that has occurred in that environment; and
3) A description of the natural condition of the environment or, if that is not available, some modified, but ecologically sustainable, condition to serve as a benchmark.

Two practical methods for depicting the environmental condition include use of the no-action alternative and an environmental reference point (see discussion under Alternatives). Historically, the no-action alternative (as reflecting existing conditions) has usually been used as a benchmark for comparing the proposed action and alternatives to existing conditions. The no-action alternative can be an effective benchmark if it incorporates the cumulative effects of past activities and accurately depicts the condition of the environment.

This document does not adequately document nor comprehensively address existing site conditions in many instances (see other sections of this review for examples) as required by 6 NYCRR Part 617 b (5). As a result, the EIS may underestimate the direct, indirect, and cumulative impacts of the proposed action.

1.3 Short and Long Term Effects

This document does not segregate nor does it adequately address short- and long-term effects of the quarry on various resources. The quarry is proposed to operate over 75 years, and in most instances, the author does not address the long-term impacts.

The document provides data from other quarry operations involving the Lockport Formation (e.g., Section 4.1.2.2, page107). However, the document provides no details on these quarries (location, former land use, size and scale of operations, duration, mitigative measures in place, etc.) and how they compare to the proposed site in terms of impacts. Therefore, the relevance and applicability cannot be appropriately reviewed and assessed.

1.4 Cumulative Effects

The combined, incremental effects of human activity, referred to as cumulative impacts, can pose a serious threat to the environment. While they may be insignificant individually, cumulative impacts accumulate over time and can result in the degradation of important resources.

The document does not adequately address or quantify the cumulative effects of the quarry operations over 75 years. Consequently, the environmental impacts are likely to underestimate impacts to the environment and human, economic and community resources.

1.5 Mitigative Measures

Mitigative measures are established to avoid or minimize damage to the environment, or to protect, restore, and enhance the environment. Section 5 provides only a superficial outline of measures to be employed, such as implementation of a sedimentation and erosion control plan, structural controls, and operating practices and engineered controls to control dust.

For instance, no plan is presented to conduct monitoring of air emissions, noise (from quarry operations or traffic), or groundwater quality over the life of the project and what actions Frontier will take if a negative impact on the environment is documented. In addition, no measures are proposed to accommodate changes in land use over time that may be impacted by quarry operations (additional residences, etc.).

Finally, no coordination or related monitoring and assessment is proposed with the Department of Interior or DOL on the Wildlife Refuge to determine if quarrying is negatively impacting the refuge or its inhabitants. Without a commitment to such measures or implementation of a strong monitoring program, Frontier will not be accountable for correcting or eliminating impacts to natural resources or human, economic, and community resources surrounding the quarry.

1.6 Irreversible and Irretrievable Commitment of Resources

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of resources that is neither renewable nor recoverable for later use by future generations. The commitment of resources refers primarily to the use of nonrenewable resources such as fossil fuels, water, and electricity.

Section 8 addresses only three resources: geologic, land, and visual. Many topics were not addressed, including air, transportation, recreation, water, soil, vegetation, terrestrial wildlife, and aquatic biological and socioeconomic resources, to verify, by alternative, if there are irreversible and irretrievable resource commitments during construction, operation, and closure of the quarry over its 75 year life. An example is provided below of what should have been documented. Without this information, the comparative effects of this proposed action cannot be objectively assessed.

Resource	Resource Impacts
Land Use	**Surface Disturbance.** Project facility construction would result in an irretrievable loss of approximately 269 acres of land due to the permanent use of land for quarrying facilities and operations that would not be reclaimed. **Groundwater Pumping.** Future groundwater drawdown would result in groundwater level reductions and possible water quality degradation that could adversely affect surface water and vegetation on adjacent lands as well as groundwater use for public consumption. These effects would be irreversible and potentially irretrievable impacts.

2.0 Iroquois Job Corps Center Related Impacts

The Iroquois Job Corps Center (Center) is not considered in the EIS with the exception of noise. The Center is approximately 3,000 ft from the proposed quarry. The Center has hundreds of residential students and staff that commute to the site using local roads. The Center may have significant impacts to traffic, air pollution, wetlands, and groundwater from the mine. Truck traffic is not considered in the air pollution or noise analyses. The EIS does not provide an adequate analysis of impacts to the Center from the proposed mine. The EIS should be revised to include impacts to the Iroquois Job Corps Center and resubmitted.

The impacts to water supply could be significant. The center has 75' depth wells that provide domestic water. Drawdown of the well could cause impacts to quantity and quality of the well water. A municipal connection is not available to the Center on Tibbits Road. An extension from a public water supply main has not been investigated or considered for Job Corps or analyzed in this report. If the Center wells are negatively affected by the mining operation, mitigation options should be evaluated.

Similarly for noise, air pollution, and wetlands impacts which have not been considered, mitigation options should be evaluated.

3.0 BASELINE AND IMPACTED RESOURCES

The following comments and observations are provided for air, groundwater, and noise resources addressed in the EIS. These two resource areas demonstrate that baseline information is incomplete and short and long term impacts, as well as cumulative effects were not addressed.

3.1 Air

The air quality analysis (Sections 3.1.3.2 and 4.1.3) does not fully address the emissions from all sources (mining, quarry processing equipment, and mobile sources, trucks), nor does it model or project total emissions and their dispersion to the surrounding community over the 75 year life of the project (Sections 3.1.3.2 and 4.1.3, Appendix 5, and Appendix 12). Appendix 5 contains data at multiple locations in New York, which are not in proximity to the site and are therefore irrelevant to this analysis.

Furthermore, the EIS cites the ambient air quality standards, then includes the statement "An analysis of the annual averages at the Rochester Station shows that the do not exceed those standards". The Rochester Station is about 43 miles away from this site, so the data are not relevant to the site conditions. Ambient levels should have been measured at this site to provide a benchmark for the alternative analysis and the projection of impacts during operations from both stationary and mobile sources.

The EIS does not address nor model the impacts of mobile source (trucks) emissions (e.g., particulates, nitrogen oxides [NOx], volatile organic compounds [VOCs], sulfur oxides [Sox], carbon monoxide [CO]) on a daily or yearly basis throughout the quarry lifetime, nor does it address cumulative impacts on the local community, wildlife, or vegetation. Without this information, the EIS does not comprehensively address short, long term, or cumulative effects of quarry operations.

Finally, the report documents a study completed by the National Stone, Sand and Gravel Association, on $PM_{2.5}$, PM_{10} and total suspended particulate (TSP) formation, composition, and

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deposition at a "typical stone crushing plant" in 1999. The comparability of the data for this "typical" plant, located in Greensboro, NC (700,000 tons per year, operating four days per week, 10 hours per day) to the proposed Frontier quarry, located in Shelby, NY [350,000 tons per year, operating Monday to Friday (6 am to 6 pm) and Saturday (6 am to 12 noon] is questionable given that the plant layout, location, production rates, and operations are so different.

The study concluded that there was no detectable impact of the plant operations on ambient $PM_{2.5}$ concentrations; PM_{10} and TSP particulate matter have different spatial and temporal trends than $PM_{2.5}$; and the observed decrease and in concentrations of TSP and PM_{10} as a function of downwind distance confirmed that there is a rapid loss of particulate matter in the course and supercoarse size ranges at about 1,000 ft downrange. The EIS concludes that a stone processing facility is an insignificant contributor to ambient concentrations of particulate matter.

While this study is extremely helpful to understand the above stated trends, there are flaws associated with the conclusion that there this type of plant is an *"insignificant contributor to ambient concentrations of particulate matter":*

- The EIS does not compare the site conditions (plant layout, capacity, production rate, local geology, topography, climatic and wind conditions etc.) of the plant evaluated (Greensboro, NC) with this site to determine if the conclusions are valid.
- The study is limited given that the evaluation only addresses several days of data in 1999. The EIS does not assess or model the seasonal, long term, or cumulative effects of plant operations on the environment and the potential accumulation of deposited particulate on land/vegetation and resuspension as a result of plant operations and mobile sources.

Finally, the EIS notes that the Federal New Source Performance Standards for stone processing plants requires no fugitive emissions may be discharged at greater than 10% opacity. However, the EIS in Section 4.1.3 does not address this air quality performance standard.

3.2 Groundwater

This section addresses Volume I and 4 and Appendix 4, respectively.

3.2.1 Volume I and 4

The following observations and comments are noted:

- Well Impacts – There is not a specific contingency plan to protect or replace the Iroquios JCC water supply if mining impacts the water supply or water quality. There is a general contingency to install replacement wells or to connect impacted residences to an existing water pipeline. That pipeline is not readily available to all potentially impacted properties. It will take time to run lateral water lines or to install new wells. A residence would require a relatively small amount of water. A property like the Iroquois JCC will require a large quantity of water. The time to correct problems would be longer. A specific contingency plan should be developed to protect and replace (if necessary) the Iroquois JCC water supply.
- Truck Traffic – Specific truck routes that avoid the Iroquois JCC and other populated areas must be developed. Truck routes were mentioned in the plan but a more detailed plan and specific routes should be presented. The routes should be the shortest route to

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major highways but they should avoid more heavily populated areas and facilities like the Iroquois JCC.

- Spill Prevention – The document does not present a detailed spill prevention plan. The reason cited was because planned quantities of fuels are small. A spill prevention and corrective measures plan should be developed. A spill in the quarry would likely directly enter the fracture controlled bedrock aquifer. Cleanup of contamination in fractured bedrock may be difficult.

- Baseline and Impacted Groundwater Quality – Frontier should have conducted a comprehensive background sampling and analysis of the soil, surface water, and groundwater should be conducted to determine if contaminants (VOCs, SVOCs, pesticides, metals, herbicides, fertilizers) are present and in what concentrations. Similar sampling should be completed when groundwater is pumped out. The EIS indicates analysis will be limited to TDS and pH. This information for a suite of analytes is critical to determine if contamination is present, and if so, determine the potential for mobilization to the surrounding environs, both in the short- and long- term.

- Groundwater Maps – What is the cause for the groundwater trough in the center of the site? The two groundwater maps look odd in the Alpha Geoscience Hydrogeologic Analysis. Alternative A does seem to match a regional map prepared by the USGS. A more thorough description of groundwater conditions would be useful to documenting the impacts of this quarry.

- Surface Water – There needs to be a plan to coordinate the quarry activities with the wetland management activities. Precipitation currently enters drainage ditches that then drain to two wetlands. Precipitation collected in the quarry and groundwater infiltration into the quarry are planned to be pumped to retention ponds and then to existing drainage ditches that will eventually enter just one of the wetlands. There was discussion about balancing water if needed to direct some water to the second wetland as presented in the Alpha Geoscience Hydrogeologic Analysis and repeated throughout the EIS. . There was also discussion of management of the wetlands to control water levels and related habitats.

- Surface Water – Will the wetlands be wetter and have average higher water levels from constant addition of water from the ditches? It is planned to pump water from the quarry to the drainage ditches year round. Currently, flow in the ditch is intermittent.

- Pumping – The highest pumping rates from the quarry are estimated to be in the early spring (March). This is also the time of greatest input of water to the wetlands from surrounding areas experiencing snow melt and precipitation.

- Groundwater – The Iroquois JCC is well within the area of influence of the quarry. Groundwater is primarily in the upper bedrock at depths ranging from 59-89 feet. The quarry will intercept this aquifer. Another study referenced found bedding plain fracture zones can extend up to 3-4 miles. The Iroquois JCC is only 4000 feet from the quarry.

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3.2.2 Hydrogeological Investigation Alpha Geoscience (Appendix 4)

The following observations and comments are noted:

- Little Site Specific Study – This study uses many investigations from outside the site area to draw conclusions and to extrapolate. Other than a 72 hour pump test conducted by Continental Placer, little work was conducted in the vicinity of the site.
- Groundwater Recharge – A study was conducted by Alpha Geoscience to estimate the areas of groundwater recharge. This was based on surface soils. On the one hand, the overall document makes the case that overburden is low conductivity and is not contributing to the water in the bedrock yet recharge through the overburden is assumed to be the source of water in the bedrock. The case is made that there is separation between the perched wetlands and the bedrock aquifer limiting vertical migration. Little is known about the vertical extents of the various soil types in the overburden. The area identified as the recharge area may not be sufficient to recharge the bedrock aquifer. Recharge is expected to be more regional.
- Confined to Unconfined Aquifer (Appendix 4 page11) – This section indicates that once the mine breaches the aquifer, it will act more like an unconfined aquifer and will have a smaller aerial effect. Will the water in the aquifer move toward the quarry in an attempt to reach equilibrium?
- Groundwater Monitoring – Groundwater monitoring should be more frequent and should extend beyond five years. The Alpha Geoscience document calls for bimonthly groundwater monitoring and annual reports for the first five years. The monitoring interval should be monthly at a minimum and should extend beyond five years. At a minimum, an annual data dump of the measurements and a set of hydrographs should be produced. As different segments of the quarry are mined, impacts to groundwater may change.
- Finished Quarry Water Holding – It is assumed finished quarry sections may be used to hold water to help control water discharges to the wetlands. These sections of the quarry will accumulate water from rain and groundwater infiltration in addition to pumped water. These areas may not have the anticipated capacity to hold water as estimated in the report.
- Wall Leakage – The walls separating completed cells from active cells are relatively thin. Will there be more leakage between the cells holding water and those being mined?
- Monitoring Well Pairs – Monitoring well pairs should be added. There appears to be four well sets to monitor impacts to the groundwater levels around the quarry operation. There are no wells on the south side of the quarry, between the quarry and the Iroquois JCC. The nearest well set is at the southeast corner of the quarry. A well set should be added south of the Phase 2 area, between the quarry and the Iroquois JCC.
- Groundwater Drawdown – An area-wide groundwater drawdown map extending to the 7,000 feet quarry impact distance or beyond should be drawn. Based on one 72-hour pump test conducted by Continental Placer, localized drawdown right at the proposed site

was shown on Figure 5. The text assumes potential for groundwater impacts up to 7000 feet from the quarry. A figure showing projected drawdown contours would be helpful.

- Regional Groundwater – A figure showing current groundwater conditions was included along with a post mining groundwater conditions map. This map was a bulls-eye around the quarry. Once conditions stabilize, the groundwater map may look more like the pre-mining map?

3.3 Noise/Traffic

The noise assessment addresses quarry operations and notes impacts to the Iroquois Job Corps Center, which will not result in disturbances to the Center (i.e., ambient levels). However, this analysis fails to account for the impact of truck traffic on the local community. The baseline noise in the vicinity of the site and the truck traffic routes (primarily Sour Springs Road and Oak Orchard Ridge Road) should be detailed and the noise and cumulative impacts addressed for 8-10 trucks/hour and up to 30 trucks/hour. Assessment of mobile source noise and related impacts is an important component of this study and should have been addressed.

Exhibit C

Sheeley, Scott E (DEC)

From: Roster, Tom <tom_roster@fws.gov>
Sent: Wednesday, November 25, 2015 6:07 AM
To: Sheeley, Scott E (DEC)
Cc: Gibbs, John (DEC); Wasilco, Mike R (DEC); Kennedy, Heidi E (DEC); Jones, Scott (DEC); Army, Steve (DEC); Kevin Brown; John Hellert; Harkawik, Dennis P (DEC); Loew, Dudley D (DEC)
Subject: Re: Frontier Stone Quarry Proposal - Draft Condition; DEC No. 8-3436-00033/00001

Scott, thanks.

We have no concern with the attached draft language.

Tom

On Fri, Nov 13, 2015 at 2:07 PM, Sheeley, Scott E (DEC) <scott.sheeley@dec.ny.gov> wrote:

Good Afternoon Tom,

As discussed this morning, the DEC has been in contact with representatives of Frontier Stone, LLC concerning the proposed Frontier Stone Quarry mine dewatering discharges. In follow-up to our contact with them this week about the discharges, they have provided a letter dated November 11, 2015 describing an alternative mine dewatering discharge location, which is attached. It is our understanding that this alternative discharge location was discussed with you or your staff during a meeting sometime last year with Frontier Stone representatives, and that the purpose of using an alternative discharge location would be to cooperate with USFWS by avoiding discharges to the Schoolhouse March complex during drawdown and low moisture management periods.

To incorporate this alternative dewatering discharge location & scenario into the Mined Land Reclamation permit that the DEC may at some point issue for this project, we have prepared a draft permit condition that would be included in any such approval. The draft permit would also include the November 11, 2015 letter and attachments as "approved documents", which is the list of materials that the applicant would have to comply with in any final permit that may be issued. This draft condition is being forwarded to you for your information and any response you may wish to provide.

Please note that we have included a proposed limit on the daily volume of discharge of 554,400 gallons. This amount equates to the upper amount the applicant has listed in their DEC water withdrawal application and is equal to 385 gallons per minute (gpm) when averaged over an entire 24 hour period. This amount is a higher rate than the 259 gpm rate analyzed in the applicant's November 11, 2015 letter. 259 gpm is the rate the applicant has estimated based on an annual average, while 385 gpm is the highest expected rate in March. The amounts estimated by the applicant for July and September are 195 gpm and 197 gpm, respectively, so if diversion is requested in the summer/fall period, the daily volume of pumping could be lower than highest or average rates estimated.

We have also copied the applicant's representatives on this e-mail and draft condition for their information as well, since we have not previously shared this condition with them and it does not reflect any input on their part. This draft condition is also based on the Department's understanding of the discussions between the Applicant and USFWS.

If you wish to provide a response to this draft condition please do so by close-of-business on November 30, 2015. If you would like to discuss this condition, or feel you need additional time, please contact me as indicated below.

Thank you.

Sincerely,

Scott E. Sheeley

Regional Permit Administrator, Division of Environmental Permits

New York State Department of Environmental Conservation

Region 8, 6274 E. Avon-Lima Rd., Avon, NY 14414

P: (585) 226-5382 | F: (585) 226-2830 | scott.sheeley@dec.ny.gov

www.dec.ny.gov | f |

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Thomas P. Roster, Project Leader

Iroquois National Wildlife Refuge

Erie National Wildlife Refuge

1101 Casey Road, Basom, New York 14013

585.948.5445 ext 7030, (fax) 585.948.9538

Join the conversation!

Iroquois National Wildlife Refuge

Erie National Wildlife Refuge

Frontier Stone Quarry, DEC Application ID 8-3436-00033/00001

Proposed Special Condition to be included in the draft Mined Land Reclamation Permit to address off-site water discharges to state-regulated wetlands on Iroquois National Wildlife Refuge:

"Upon written request by the United States Fish and Wildlife Service (USFWS), the Permittee shall use the alternative mine dewatering route identified as "drainage basin 2" in the letter dated November 11, 2015 from John Hellert to Scott Sheeley. Use of the alternative discharge location shall:

- Occur for the full period specified by the USFWS request,
- Be the minimum seasonally necessary to achieve proper mine dewatering, but at no time exceed a rate of 554,440 gallons per day, and
- Meet all effluent limits and requirements of the Permittee's coverage under the State Pollutant Discharge Elimination System (SPDES) Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity (GP-0-12-001)."

Exhibit D

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Charles W. Malcomb
Direct Dial: 716.848.1261
Direct Facsimile: 716.819.4737
cmalcomb@hodgsonruss.com

Hodgson Russ LLP
ATTORNEYS

June 9, 2014

Via U.S. First Class Mail, E-Mail, and Facsimile

RECEIVED
JUN 11 2014
DEP REGION 8

Scott E. Sheeley
NYSDEC – Region 8 Office
6274 Avon-Lima Road
Avon, New York 14414-9519

Dear Mr. Sheeley:

Re: *Matter of Frontier Stone, LLC*
DEC File Nos. 8-3436-00033/00001; 8-3436-00033/00002

As you know, our office serves as special counsel to the Town of Shelby (the "Town") with regard to the above-referenced matter. I submit this letter as a supplement to my testimony at the public hearing on behalf of the Town, and to further comment on the sufficiency of the draft environmental impact statement ("DEIS"). While we appreciate the Department's determination to extend the public comment period, we are disappointed by the Department's decision not to hold another public hearing.

As noted during my public hearing testimony, the Town has reviewed the DEIS that has been accepted by the New York State Department of Environmental Conservation ("NYSDEC") for public review and has determined that further study and analysis is required with respect to several critical areas.

Land Use/Conformance With Community Plans And Goals

First, Section 4.2.2 of the DEIS identifies and analyzes the potentially significant environmental impacts related to land use and zoning. Section 1.2.2 states that the proposed mine parcels are located within the AR District. These sections indicate that mining is allowed upon "petition" to the Town Board. Some clarification is necessary.

Mining is only allowed in the Town's Industrial District, and only upon the creation of a Mining/Excavation Overlay District, which is available through an application to the Town Board. Mining/Excavation Overlay Districts may only be created within areas currently zoned Industrial. Frontier Stone's application for a rezoning is not merely the creation of a Mining/Excavation Overlay District, but a zoning change of the underlying zoning district/classification from AR to Industrial. In addition, site plan approval and a special use permit is required.

Any applicant may, of course, apply for a rezoning at any time, but the Town Board has the obligation to ensure compliance with the comprehensive plan, the community character, the public health, safety, and welfare, and other reasonable considerations that may be relied upon by a legislative body. As the Lead Agency, the NYSDEC has the obligation to evaluate the proposed action in accordance with the character of the surrounding land uses, including the Iroquois National Wildlife Refuge.

The impacts to the community, the community's plans and goals, and nearby land uses including the Iroquois National Wildlife Refuge ("INWR") and the Iroquois Job Corps Center ("IJCC") are among the critical considerations that must be evaluated. The current zoning of the property, Agricultural-Residential, is compatible with the surrounding uses and the INWR. The purpose of the AR District, as set forth in Section 510 of the Town Zoning Code, "is to protect agricultural lands and uses from incompatible uses and development; to maintain an open rural character of the community; to assure compatible types and densities of development; to provide for low density, rural development; and to protect the natural environment." The proximity to the INWR is a critical issue.

Proximity To The INWR And Impacts To Wildlife

The INWR serves primarily as nesting, feeding, resting and staging areas for migratory waterfowl and contains various habitats that support approximately 266 species of birds, 42 species of mammals, plus reptiles, fish, amphibians, and insects. The INWR is also critical for recreation, hunting, fishing, and bird-watching. The INWR is an environmental treasure that should be protected and preserved.

In the vicinity of the project site, the Short-Eared Owl, an endangered species, is found. The Bald Eagle, Northern Harrier, and Henslow's Sparrow are threatened species in the area. The Vegetation and Wildlife Resources Report and Impact Analysis of Ecological Resources, attached as Appendix 6 to the DEIS, discusses the various endangered or threatened avian species in the vicinity of the project, and notes that noise and vibrations that result from blasting and other mining operations can potentially affect wildlife. Loud abrupt noises can startle animals, and cause them to leave a foraging area or abandon nests. The Report evaluates the impacts on Henslow's Sparrow, but does not contain sufficient analysis of these impacts on the Short-Eared Owl or other threatened species, known to nest or forage in the vicinity of the project. The DEIS provides that the Short-Eared Owl nests on the ground or in grass, so vibrations from blasting would be critical to evaluate.

Wetlands And Water Quality

The wetlands in the INWR are essential parts of wildlife habitat within the Refuge. Concerns have been raised as to the effect of the quarry's dewatering and quarry discharges on the wetlands in the Refuge. The Hydrogeologic report, attached to the DEIS as Appendix 4, comes to the conclusion that "no impact to wetlands or waterbodies will occur on the site from the quarry development." This conclusion is based upon "observations that the water levels in the wetlands are associated with the shallow water table, that a thick (30 ft) deposit of underlying, low permeability, silt and clay isolate the wetlands from the bedrock aquifer, and that the water levels in the bedrock are already below the levels in the wetlands." It is unclear what other analysis was performed other than to note the water levels and discuss the soil layer. It is unclear whether the claimed isolation of wetlands has been verified for all potentially impacted wetlands, or just within a single area. Given the importance of the wetlands to the Refuge and the critical habitat areas, additional study is warranted with respect to the quarry's impact on wetlands. Specifically, completion of additional independent study or a peer review of the Hydrogeologic report is warranted.

According to the Hydrogeologic Analysis, surface water flowing into the Refuge from the quarry could reach 1083.53 gpm from the current 185.33 gpm. Stormwater and water from quarry dewatering will come into contact with sediment, dust, pollutants (lubricants, petroleum) and will be discharged in to the Refuge. While some mitigation will be achieved through a stormwater pollution prevention plan ("SWPPP") and the design in the Mined Use Plan, significant attention must be paid to this impact, since it will directly affect the Refuge and wetland areas. It is unclear whether these impacts will be adequately mitigated, given that the discharge affects the Refuge. Further comments on mitigation resulting from sediment or other pollutants should be evaluated further.

In addition, the disruption of private water wells was noted with a projected drawdown out to 7,000 feet. The Iroquois Job Corps Center ("IJCC") is well within the drawdown area, but it appears no specific analysis was performed with respect to the impacts on this well. The IJCC utilizes 36,000-40,000 gallons per day of potable water from ground sources. There will be an impact, as the IJCC is within the drawdown area. There is no practical way to achieve a public water source, as was noted as a possibility for other affected wells, and the mitigation plan proposed for regular wells appears inadequate. Disruption of potable water availability would result in the imposition of significant costs and the many students residing at the IJCC would have to be relocated.

Impacts To The IJCC

The IJCC is a no-cost education and career technical training program administered by the U.S. Department of Labor. The IJCC assists young people, ages 16 through 24, to improve the quality of their lives through career technical and academic training.

The IJCC is located approximately 1,300 feet from the proposed mining operation. In accordance with its mission, the IJCC houses up to 255 students in dormitories located near the proposed quarry and employs approximately 110 staff members. The proximity of student housing, education, and recreation so close to the proposed quarry presents significant adverse environmental impacts of concern. First, with respect to traffic, there will be a significant increase of heavy truck traffic as the result of the mining operation. As stated in the DEIS, the proposed mining site will be accessed by Sour Springs Road, a local road. The main entrance to the IJCC is also located on Tibbets Road, accessed via Sour Springs Road, and the local roads have been available for pedestrian use. The DEIS indicates that there will be almost ongoing truck traffic entering and exiting the site, with trucks entering and/or exiting the site

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onto Sour Springs Road every 75 seconds. The increased truck traffic resulting from the mining operation creates safety concerns for the youth living at the IJCC, and the noise and air quality impacts from the additional truck traffic will adversely impact the IJCC.

Blasting, including the resulting adverse impacts from noise and dust, is another aspect of the application that will adversely impact the INWR and the IJCC. Operation of the mine and blasting will impact the IJCC and students' activities. The blasting operations are also likely to impact the INWR areas closest to the IJCC. This is a particularized impact to the IJCC, which has not been adequately addressed by the DEIS. For example, the DEIS identifies an "area of influence" where the applicant has concluded that the majority of the impacts to the INWR will occur. If this "area of influence" is even close to accurate, the INWR areas near the IJCC will be impacted at an even greater level. One potential consequence of the "area of influence" would be to impact wildlife that had been located in the INWR closest to the IJCC. Wildlife that had been available for students' observation and enjoyment would be negatively impacted by the mining operation and would likely relocate, as was alluded to in the DEIS. The location of the IJCC in a quiet, secluded, and serene environment is crucial to the IJCC's mission. A mining operation will be disruptive. Moreover, the blasting impacts to the integrity of the IJCC's buildings, structures, and overall campus have not been adequately studied or evaluated in the DEIS.

In addition to the impacts to potable water availability noted above, traffic, blasting, noise, dust, and groundwater impacts, student safety is another significant concern. Up to 255 young students reside at the dormitory facilities in the INWR area adjacent to the proposed mining site. The location of a heavy industrial use so close to student housing is a safety hazard. An open pit will be created as part of the mining operation, there will be heavy machinery operating, and there will be excess commercial traffic.

Another adverse impact to the INWR and the IJCC is the significant quarry discharge that will enter the INWR. Stormwater and water from quarry dewatering will come into contact with sediment, dust, machinery, product, and pollutants and will be discharged into the INWR. A conservative estimate is that 500,000 gallons per day of waste water will be discharged into the INWR. This is a significant impact that has not been fully evaluated.

The wetlands in the INWR are an essential part of wildlife habitat and are an important part of the students' environment. The Town has significant concerns with respect to the quarry's dewatering and quarry discharges on the wetlands in the INWR. The DEIS comes to the conclusion that there will be no impact to wetlands or water bodies from the quarry development. This conclusion is based upon observations of the water levels in the wetlands and a discussion of the soil layer. It is unclear how this conclusion was reached, the analysis that was done to substantiate it, and whether this analysis applies to all wetlands or merely a portion. Additional study and information is critical. From the information provided in the DEIS thus far, dewatering and quarry discharge has the potential to significantly impact the INWR's wetlands.

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Impacts To Recreation Resources

With respect to the impacts to recreation, Section 1.3.3.2 indicates that a map was created "to facilitate discussion of impacts to wildlife and recreational users within the Area of Influence (AOI)." The DEIS provides cursory discussion of the impacts to recreational use of the Refuge. Canoeing, fishing, and hiking are deemed to be outside of the AOI, so there was no discussion. The section on bird watching provides that it will not be effected because bird watchers like to go elsewhere. Impacts to hunting is still unclear. Hunting is allowed in the AOL and there will be overlap of hunting season with quarry production season. There is a cursory discussion that there is no potential for significant impact to recreational hunting from development of the quarry because the property owner posted the property. But, the effect of production on nearby hunting should be evaluated.

Reclamation Plan

The Reclamation Plan will essentially turn the site into two rectangular lakes at the conclusion of the approximately 75-year life of the mine. Presumably, these will be utilized for recreation and wildlife. At the end of the life of the mine, the land will not be available for additional uses. While recreation is important, the site will be lost to uses such as agriculture and residential, which is the current zoning, consistent with the Town's comprehensive plan. The nature of the reclamation would preclude reclamation during the life of the mine. It is unclear what alternative reclamation options have been considered. There is no rationale for rejection of alternatives. The DEIS at Section 7.1 mentions alternative reclamation design in only the most cursory way. "Alternatives in reclamation design which would prepare the site for secondary land use are few." Alternatives should be fully discussed and vetted in the DEIS.

The Town appreciates the opportunity to fulfill its role as an involved agency by submitted these comments, and we respectfully request that additional analysis and study is warranted on these important issues. Please feel free to contact me with any questions you may have.

Sincerely,

Charles W. Malcomb

CWM/bcl
cc: Kevin J. Brown, Esq.
Daniel A. Spitzer, Esq.
Town Board

Exhibit E

USGS
science for a changing world

Prepared in cooperation with the U.S. Fish and Wildlife Service

Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009–2010

Scientific Investigations Report 2012–5027

U.S. Department of the Interior
U.S. Geological Survey

Cover. All photos from the Iroquois National Wildlife Refuge photo archives.
Upper Left - Cayuga Marsh overlook at NY-Route 77, autumn scene.
Right - Ice fog (hoar frost) view of wetland behind Iroquois Refuge office building along Casey Road, midwinter.
Lower left - Oak Orchard Creek looking downstream from Knowlesville Road, on the eastern side of the Refuge, early autumn.

Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009–2010

By William M. Kappel and Matthew B. Jennings

Prepared in cooperation with the U.S. Fish and Wildlife Service

Scientific Investigations Report 2012–5027

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

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Conversion Factors, Datum, and Abbreviations

Multiply	By	To Obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
mile, nautical (nmi)	1.852	kilometer (km)
yard (yd)	0.9144	meter (m)
	Area	
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

List of Acronyms

DEIS	Draft environmental impact statement
ET	Evapo-transpiration
GPS	Global Positioning System
NWQL	National Water Quality Laboratory
NYSDEC	New York State Department of Environmental Conservation
PVC	Polyvinyl chloride
USGS	U.S. Geological Survey
WMA	Wildlife Management Area

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Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009–2010

By William M. Kappel and Matthew B. Jennings

Abstract

A 2-year study of the water resources of the Iroquois National Wildlife Refuge (Refuge) in western New York was carried out in 2009–2010 in cooperation with the U.S. Fish and Wildlife Service to assist the Refuge in the development of a 15-year Comprehensive Conservation Plan. The study focused on Oak Orchard Creek, which flows through the Refuge, the groundwater resources that underlie the Refuge, and the possible changes to these resources related to the potential development of a bedrock quarry along the northern side of the Refuge. Oak Orchard Creek was monitored seasonally for flow and water quality; four tributary streams, which flowed only during early spring, also were monitored. A continuous streamgage was operated on Oak Orchard Creek, just north of the Refuge at Harrison Road. Four bedrock wells were drilled within the Refuge to determine the type and thickness of unconsolidated glacial sediments and to characterize the thickness and type of bedrock units beneath the Refuge, primarily the Lockport Dolomite. Water levels were monitored in 17 wells within and adjacent to the Refuge and water-quality samples were collected from 11 wells and 6 springs and analyzed for physical properties, nutrients, major ions, and trace metals.

Flow in Oak Orchard Creek is from two different sources. During spring runoff, flow from the Onondaga Limestone Escarpment, several miles south of the Refuge, supplements surface-water runoff and groundwater discharge from the Salina Group to the south and east of the Refuge. Flow to Oak Orchard Creek also comes from surface-water runoff from the Lockport Dolomite Escarpment, north of the Refuge, and from groundwater discharging from the Lockport Dolomite and unconsolidated deposits that overlie the Lockport Dolomite. During the summer and fall low-flow period, only small quantities of groundwater flow from the Salina shales and Lockport Dolomite bedrock and the unconsolidated sediments that overlie them; most of this flow is lost to wetland evapotranspiration, and the remainder enters Oak Orchard Creek. Water quality in the Oak Orchard Creek is affected not only by these groundwater sources but also by surface runoff from agricultural areas and the New York State Wildlife Management Area east of the Refuge.

Based on the results of the drilling program, the Lockport Dolomite underlies nearly all the Refuge. The Refuge wetlands lie within a bedrock trough between the Lockport Dolomite and Onondaga Limestone Escarpments, to the north and south, respectively. This bedrock trough was filled with mostly fine-grained sediments when Glacial Lake Tonawanda was present following the last period of glaciation. These fine-grained sediments became the substrate on which the wetlands were formed along Oak Orchard Creek and nearby Tonawanda Creek, to the south and west. Water quality in the unconsolidated and bedrock aquifers is variable; poor quality water (sulfide-rich "black water") generally is present south of Oak Orchard Creek and better quality water to the north where the Lockport Dolomite is close to the land surface. A set of springs, the Oak Orchard Acid Springs, is present within the Refuge; the springs are considered unique in New York State because of their naturally low pH (approximately 2.0) and their continual discharge of natural gas.

The potential development of a bedrock quarry in the Lockport Dolomite bedrock along the northern border of the Refuge may affect the nearby Refuge wetlands. The extent of drawdown needed to actively quarry the bedrock could change the local hydrology and affect groundwater-flow directions and rates, primarily in the Lockport Dolomite bedrock and possibly the Oak Orchard Acid Springs area, farther to the south. The effect on the volume of flow in Oak Orchard Creek would probably be minimal as a result of the poor interaction between the surface-water and the groundwater systems. Of greater potential effect will be the possible change in the quality of water flowing into the Refuge from the discharge of groundwater during dewatering operations at the quarry; this discharge will flow into the northern part of the Refuge and affect the quantity and quality of wetland areas downstream from the quarry discharge. These changes may affect wetland management activities because of the potential for poor-quality water to affect the ecology of the wetlands and the wildlife that use these wetlands.

Introduction

In fall 2008, the U.S. Geological Survey (USGS), in cooperation with the U.S. Fish and Wildlife Service-Iroquois National Wildlife Refuge, (referred to throughout this report as the "Refuge") commenced a study of the surface-water and groundwater resources within and surrounding the Refuge in western New York. The Refuge straddles the boundary between Genesee and Orleans Counties in northwestern New York, and is located between the cities of Rochester, N.Y., to the east and Buffalo, N.Y., to the west. On either side of the Refuge, the New York State Department of Environmental Conservation (NYSDEC) maintains wildlife management areas along Oak Orchard Creek to the east of the Refuge and adjacent to Tonawanda Creek to the southwest of the Refuge (fig. 1).

The Iroquois National Wildlife Refuge was created in 1958 as the Oak Orchard National Wildlife Refuge but was renamed Iroquois National Wildlife Refuge in 1964 so as to not confuse it with the neighboring New York State Oak Orchard Wildlife Management Area (WMA). These wildlife management areas serve the western portion of the Atlantic Flyway (a major water-fowl and song-bird migration route) and the Refuge encompasses more than 10,200 acres of land, including forest, grassland, emergent marsh, and hardwood swamp. These habitats serve as nesting, resting, staging, and feeding areas for 268 species of migratory birds, including many threatened and endangered species in the State. The Refuge is also a year-round home to hundreds of species of birds, mammals, amphibians, fish, reptiles, and insects: (Iroquois National Wildlife Refuge, undated).

In 2010, the Refuge began the development of a 15-year Comprehensive Conservation Plan that will serve as a guide to current and future management of the various habitats that support numerous species of migratory and permanent wildlife that use the Refuge. The interconnection of the surface-water and groundwater systems affects water levels and wildlife- and habitat-management operations within the Refuge. An issue of importance to future comprehensive conservation planning is a proposed bedrock quarry along the Refuge's northern border. This quarry has the potential to affect the natural hydrology of the Refuge and the water quality of its wetlands, streams, springs, and Oak Orchard Creek, which flows through the middle of the Refuge.

Purpose and Scope

This report describes the hydrogeology of the unconsolidated glacial deposit and underlying bedrock aquifers within and near the Refuge and includes descriptions of (1) the glacial and bedrock geology; (2) the groundwater-flow system, including water levels and groundwater and surface-water interaction; and (3) the water quality of both surface water and groundwater, including nutrients and common ions. Also included in this report are figures and tables that indicate the location of (1) wells used to determine groundwater level and groundwater quality in the unconsolidated and bedrock aquifers; (2) streamflow sites used to determine flow and collect water-quality samples; (3) results of water-quality analyses for surface water and groundwater; and (4) hydrographs of water-level fluctuations in 17 wells in and around the Refuge and at three other regional locations, in addition to stage hydrographs for Oak Orchard Creek at Sour Springs and Harrison Roads.

Description of Study Area

The Iroquois National Wildlife Refuge is located on the Lake Ontario Plain about 15 miles south of Lake Ontario (fig. 1). The wetlands, which are partly within the State and Federal wildlife management areas, are also within the boundary of former Glacial Lake Tonawanda, which existed about 10,000 years ago as glacial ice was receding into Canada. This glacial lake initially extended from the present-day Niagara River, eastward through the Refuge to near Holley, N.Y. (fig. 1), as described in greater detail in a "Glacial Geology" section. As the glacial ice receded north, the Earth's surface slowly rebounded, and the glacial lake began to shrink in size from east to west until the entire lake drained at the Niagara River Gorge, leaving a flat lacustrine clay and silt lakebed where the State and Federal wetlands are present today.

The glacial lake was bounded on the south by the Onondaga Limestone Escarpment and on the north by the Lockport Dolomite Escarpment. Between these two carbonate rock units lie the shales and evaporites of the Salina Group, which are more easily eroded by glacial activity than the carbonate bedrock. A natural east-west trending bedrock trough was created in which the glacial lake formed and the wetlands presently reside. The Refuge complex lies on the northern side of the glacial lake, therefore most of the Refuge overlies the Lockport Group. Further to the south, the remaining wetland and upland areas overlie the Salina Group. The glacial landforms include silty clay bottomlands; clayey, silty, and sandy beach ridges; and some small till-cored moraines. To the north of the Refuge, the Lockport Dolomite crops out at land surface and forms the Lockport Escarpment in this area.

Oak Orchard Creek rises near the Onondaga Limestone Escarpment, flows into the southeastern edge of former Glacial Lake Tonawanda, and continues northwestward into the Refuge. The creek then turns north toward Shelby, N.Y., and follows the former Medina Spillway of Glacial Lake Tonawanda over the Lockport Escarpment, gaining additional flow from its remaining watershed as the creek flows to Lake Ontario at Point Breeze, N.Y. (fig. 1).

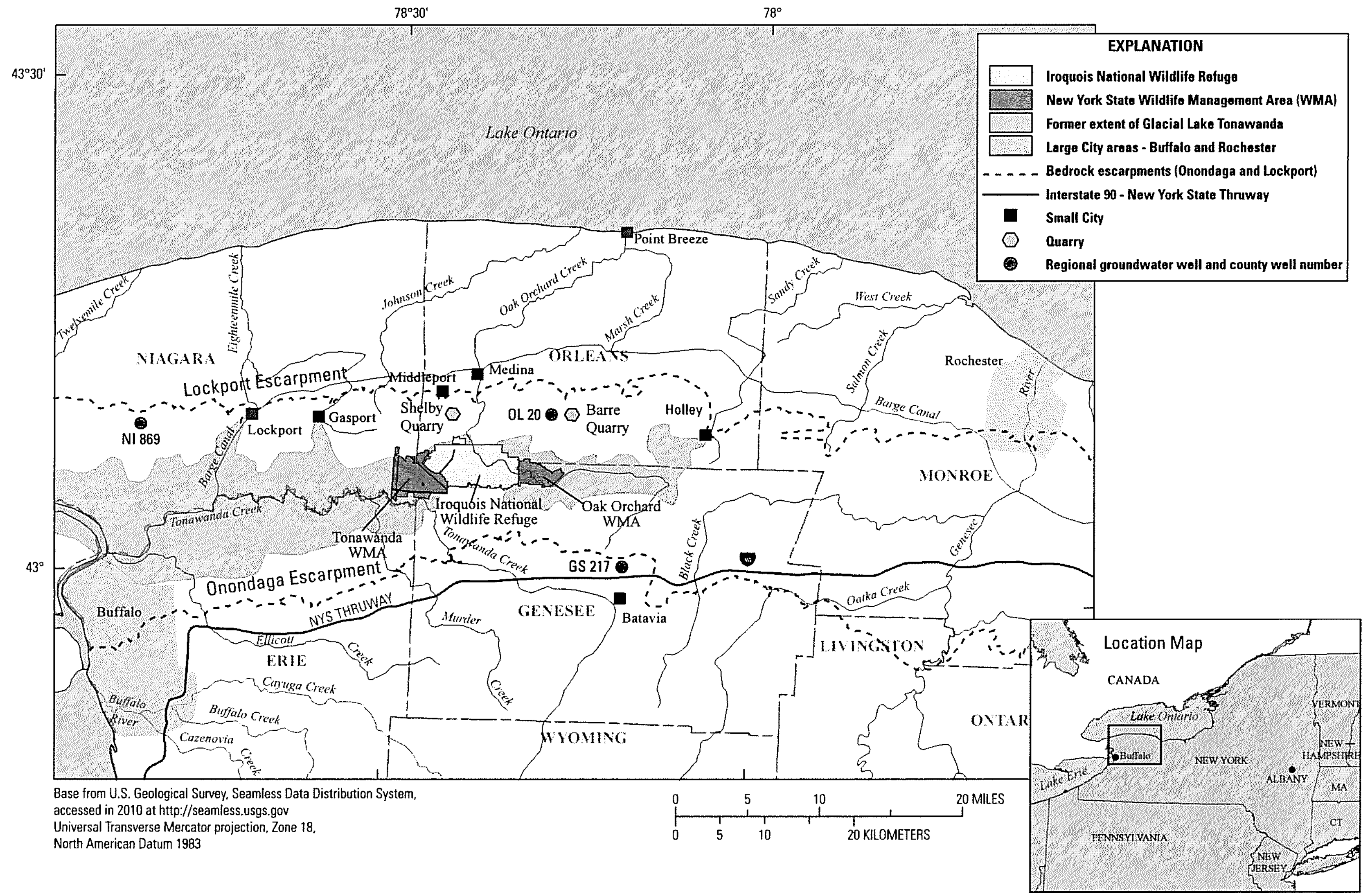


Figure 1. The location of the Iroquois National Wildlife Refuge and adjacent New York State Wildlife Management areas (WMAs). the Lockport Dolomite and Onondaga Limestone Escarpments, Lockport Dolomite quarries, and regional groundwater-level monitoring wells, Genesee, Orleans, and Niagara Counties, New York..

Data Collection

During the 2-year field study of the Refuge, various types of data were collected to assess the water resources. Meteorological data were supplied by the Refuge weather station located at the headquarters building. Soil, geologic, and hydrogeologic data were determined from (1) existing reports, (2) four bedrock wells drilled within the Refuge, and (3) 17 continuous-water-level monitors use to determine seasonal water-level fluctuations in the unconsolidated and bedrock aquifers underlying the Refuge. Water-quality samples were collected from streams and existing and newly-drilled test wells across the Refuge. A continuous streamgage was established on Oak Orchard Creek at Harrison Road (station 04220045; fig. 2) just north of the Refuge to monitor flow from the Refuge and to relate flow to precipitation and management activities in the Refuge.

Geologic Data

Data were collected to determine the types and extent of glacial deposits present in the Refuge and surrounding region. Records from drinking-water wells, test holes for bridges and roadways, and test wells drilled by the Refuge and the USGS provided information on the glacial deposits and the underlying bedrock.

Well Inventory and Test Drilling

Data from the Water-Well Reporting Program of the NYSDEC-Division of Water, (2000–2009) were retrieved for Genesee and Orleans Counties. Individual well records were reviewed, and 11 wells located near the Refuge provided information on the depth to bedrock, types of unconsolidated deposits and bedrock, estimated water yield from wells (gallons per minute), and general water quality (rated "good" to "poor" by the well driller). Records of wells drilled before the creation of the Refuge were not available as these wells were drilled prior to the Water-Well Reporting Program, which began in 2000, and the Refuge did not have any historic well data on file.

Four deep test holes were drilled on the Refuge for this study to further characterize the nature of the bedrock and the regional character of the groundwater-flow system within the bedrock of the Lockport Group dolomites. Three of the four test holes were drilled into the upper Rochester Shale to determine the regional dip of the bedrock, as well as the changes in groundwater quality with depth. A fourth test hole was drilled with the assistance of the Friends of the Iroquois National Wildlife Refuge, but due to limited funding, the hole was drilled only into the middle of the Lockport Dolomite sequence.

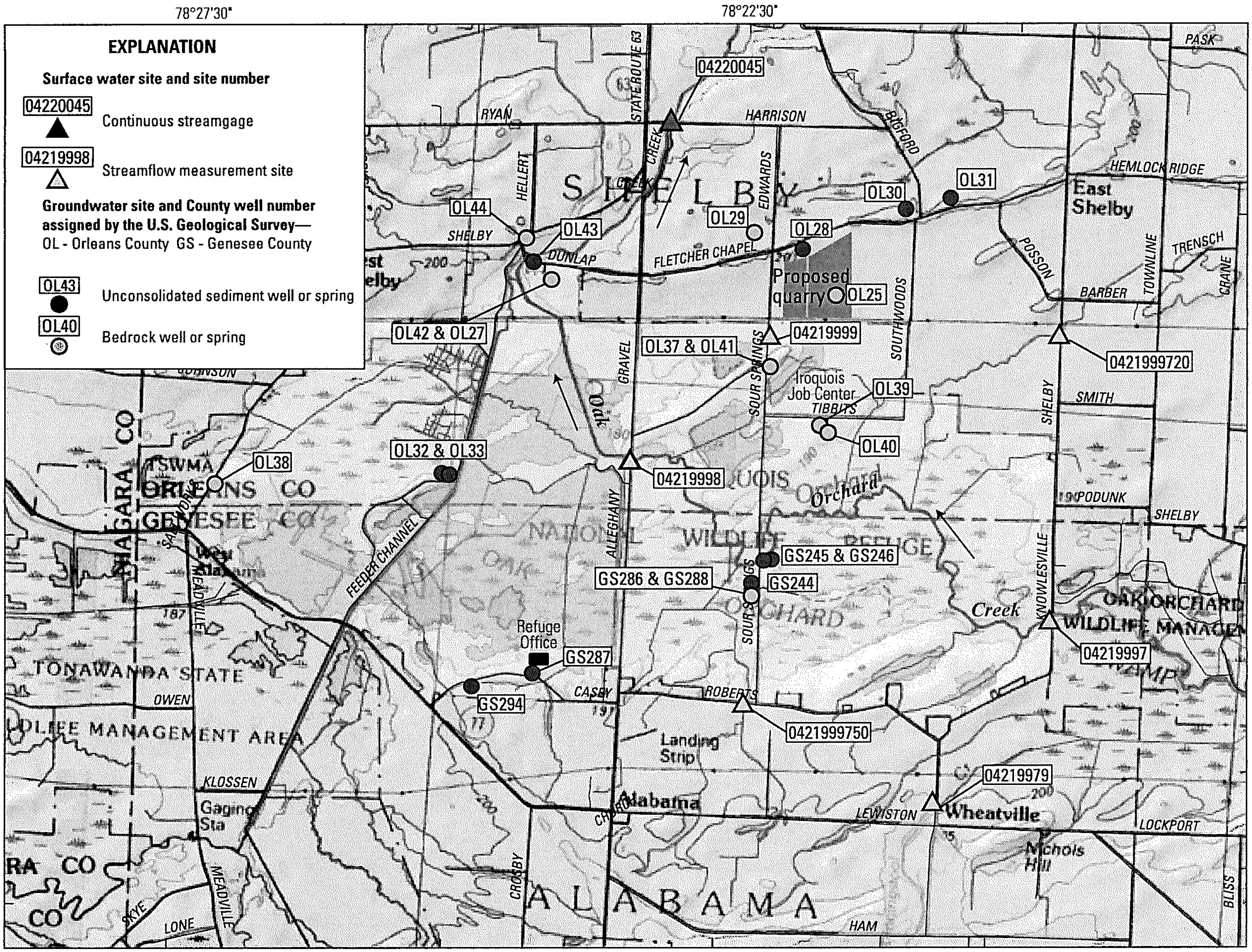
Unconsolidated deposits were characterized by inspecting the drill cuttings as the hole advanced into the bedrock. A steel casing was set in the upper bedrock, and the casing driven until refusal. Drilling then continued in bedrock to the desired depth or until the Rochester Shale was penetrated. The bedrock penetrated by each test hole was characterized by (1) inspecting the drill cuttings, (2) testing the quality of water returned to the surface for specific conductance, temperature, and salinity, and (3) borehole geophysical logging once the test holes were completed. This information was used to separate the open bedrock portion of each test hole into two distinct intervals for water-quality and water-level monitoring.

To separate the bedrock portion of each test hole into two monitoring intervals, a shale-packer assembly (fig. 3) was attached to a 2-inch polyvinyl chloride (PVC) pipe and lowered to a designated depth in the well. The 2-inch pipe string was held in place at the top of the well, and the shale-packer assembly was initially backfilled with about 2 feet of sand, and then about 5 feet of bentonite-cement grout was pumped on top of the sand layer to seal and separate the borehole into two monitoring sections. The lower interval of the borehole was accessed through the 2-inch PVC pipe, whereas the upper bedrock interval was accessed in the annular space between the 6-inch dilled hole and the 2-inch PVC casing. The test holes at Oak Orchard Ridge Road (OL37 and OL41), Sour Springs Road (GS286 and GS288), and Dunlap Road (OL42 and OL27) were completed using this method. The test hole at Salt Road (OL38) was not separated because the only source of water for this location came from the upper bedrock and a small lens of sand and gravel at the bedrock surface; the bedrock part of the test well did not yield any measurable water down into the Rochester Shale.

Two additional pairs of wells were installed within the Refuge using a small truck-mounted drilling rig. The wells were drilled to monitor shallow water-level fluctuations because they might be affected by nearby water bodies. One well pair was installed adjacent to Oak Orchard Creek near the former Sour Springs Road bridge over the creek. The first set of wells (GS245 and GS246; fig. 2) was installed at depths of 6.5 feet and 16.0 feet, respectively, and for each casing, a bentonite seal was placed above the 2.5-foot-long well screen. The second set of wells (OL32 and OL33 on fig. 2) was installed near the Feeder Channel on the west side of the Refuge in Sutton Marsh. The wells were 7.0 feet and 14.5 feet deep, respectively, and each casing had a bentonite seal above the 2.5-foot-long well screen.

Groundwater Level and Streamflow Measurements

Continuous groundwater-level monitoring was accomplished by using downhole data loggers that recorded water-level fluctuations to a hundredth of a foot (accuracy to the nearest tenth of a foot) on an hourly basis. Data from the loggers were downloaded every 3 to 4 months for processing. Groundwater-level measurements to a hundredth of a foot were made during site visits using an electric tape from a known reference point at the top of each well casing. The reference point was leveled, in most cases, to a stable benchmark located in proximity to the well, although in



Base from U.S. Geological Survey, Seamless Data Distribution System, accessed in 2010 at http://seamless.usgs.gov
Universal Transverse Mercator projection, Zone 18,
North American Datum 1983

Figure 2. The location of surface-water and groundwater sites and station numbers used for water-quality sampling and flow monitoring in and around the Iroquois National Wildlife Refuge, Genesee (GS) and Orleans (OL) Counties, New York.

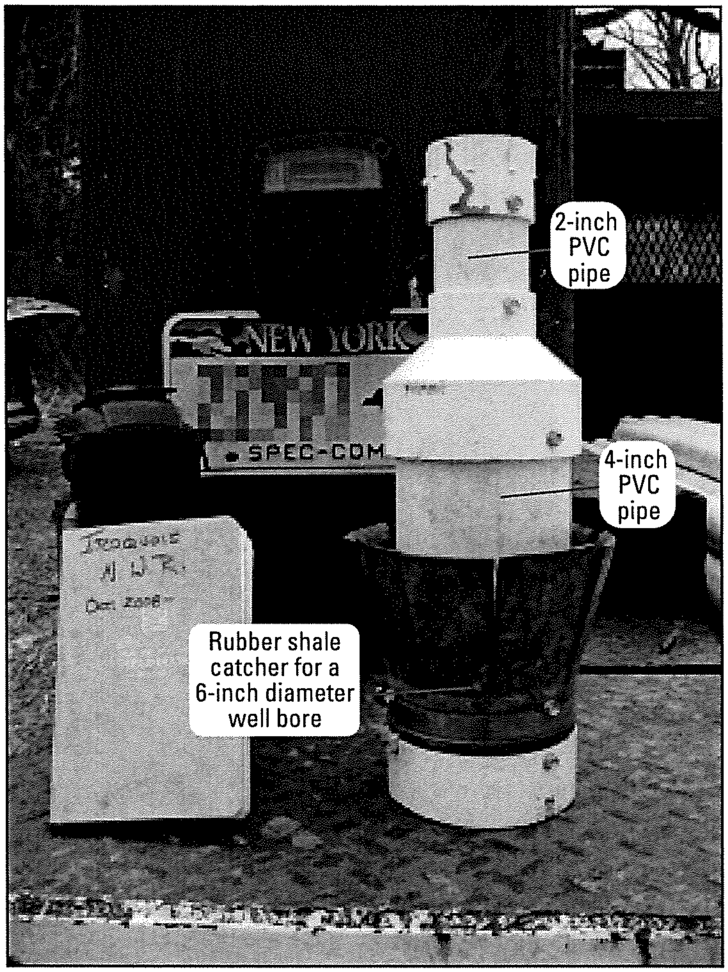


Figure 3. Shale-packer assembly used to separate three Lockport Dolomite test holes into two monitoring intervals in the Lockport Dolomite bedrock, Genesee and Orleans Counties, New York. (PVC, polyvinyl chloride).

several cases, the elevation-level surveys were several miles in length. In a few cases, there was no nearby benchmark so a Global Positioning System (GPS) unit was used to determine a local reference elevation. Although measurements from the GPS unit were considered reliable to a hundredth of a foot, the accuracy was again considered to be to the nearest tenth of a foot. The computed local elevation was then converted from the North American Vertical Datum of 1988 (NAVD88) to the National Geodetic Vertical Datum of 1929 (NGVD29) (Refuge datum) to provide the elevation of the remote well sites on the Refuge.

Streamflow measurements were made seasonally along Oak Orchard Creek from November 2008 through November 2010. Several tributary streams to Oak Orchard Creek were measured only during spring runoff in 2009, because most tributary channels to Oak Orchard Creek are usually dry by early summer, with flow returning to them late in the fall or winter. Streamflow-measuring techniques are described by Buchanan and Somers (1982). The seasonal measurements for Oak Orchard Creek were made at three locations: Knowlesville Road on the eastern side of the Refuge (04219997); State Route 63, located approximately in the middle of the Refuge (04219998); and Harrison Road, just north of the Refuge (04220045; fig. 2). The other measurement sites were on Brinningstool Creek entering the Refuge to the southeast (04219979), Tributary 3 at Shelby Road to the northeast (0421999720), Schoolhouse Marsh Tributary to the north (04219999), and Tributary 2 at Roberts Road to the south (0421999750; fig. 2; table 1).

A continuous streamgage was installed just north of the Refuge on Oak Orchard Creek at Harrison Road, near Shelby, N.Y., on December 3, 2008. The gaging equipment records nearly-continuous stage (water level) data from a pressure-sensor located in the creek at 15-minute intervals on an electronic data logger. These data were manually downloaded every 2 months for analysis and posted on the USGS New York Water Science Center's Web page (http://ny.water.usgs.gov/). Streamflow measurements were collected on a routine basis to develop a stage-discharge relation. Using the stage data collected at the site and the stage-discharge relation, the continuous record of stage is converted to a continuous record of discharge. More detailed information about the USGS stream-gaging program is presented by Blanchard (2007).

Water levels at the Harrison Road gage are normally controlled by a bedrock riffle under the bridge at lower flows and by the downstream channel at mid-to-high flows. During the first year of streamgage operation, an unknown condition downstream apparently created substantial backwater; a debris jam or beaver dam located some distance downstream is suspected. This condition cleared after high flows the following spring. On May 15, 2009, the stage of Oak Orchard Creek dropped below that of the pressure sensor. This condition was not discovered until the next scheduled site visit on June 11, 2009. At that time, the pipe housing the sensor was extended lower into the water. Therefore, there is a gap in the continuous record between the May 15 and June 11, 2009, however, most of the streamflow measurements collected at Harrison Road provided a definitive stage-discharge relation, and the gage record is rated "good," that is, 95 percent of the daily streamflow values are within 10 percent of the stage-discharge relation (Rantz, 1982).

Water-Quality Sampling and Analyses

Water quality was determined across the Refuge for both surface water and groundwater (appendix 1). Surface-water-quality samples were collected seasonally in Oak Orchard Creek between November 2008 and September 2010, and a set of spring runoff samples was collected from several tributary streams in late March 2009. The samples were analyzed for inorganic constituents and nutrients by the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado. In addition, the last three Oak Orchard Creek sample sets in 2010 were analyzed for trace metals. Field measurements of pH, specific conductance, salinity, temperature, and dissolved oxygen were made for each sample. The stream samples were collected using the equal-width-increment method and processed following methods described in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated).

Groundwater-quality samples collected from eight wells across the Refuge during 2009–10 were analyzed for nutrients, inorganic constituents, and trace metals. Three samples were collected from the lower Lockport Dolomite section of the Dunlap Road (OL42), Sour Springs Road (GS286), and Oak Orchard Ridge Road (OL37) wells. Six samples were collected from the upper Lockport Dolomite section of the Dunlap Road (OL27), Sour Springs Road (GS288), Salt Road (OL38), and Oak Orchard Ridge Road (OL41) wells and from two production wells at the Iroquois Job Corps Center (OL39 and OL40). Samples also were collected from the sand and gravel zone on top of bedrock at the Sour Springs Road (GS244) and Refuge office wells (GS287). Water from all these wells was pumped through a 2-inch submersible pump, and the sample was collected after several (at least three) casing-volumes of water were removed and field measurements of specific conductance, salinity, and temperature had stabilized.

Six springs were sampled in the Refuge in 2009 and 2010—a sulfur-water spring along Oak Orchard Creek at the Dunlap Road Bridge (OL43), a fresh-water spring discharging from the Lockport Dolomite near the intersection of Dunlap and Shelby Roads (OL44), and four of the Oak Orchard Acid Springs located near Oak Orchard Creek on the eastern side of the Refuge (GS290, GS291, GS292, and GS293). The spring samples were collected from either the discharge of the spring or, in the case of the Acid Springs, from each spring pool, at a depth of about 6 inches below the water surface. Field measurements of pH, specific conductance, salinity, temperature, and dissolved oxygen were made at all the springs. (At the request of the Refuge, the location of the Oak Orchard Acid Springs is not shown in this report because of the Springs' remote location and historic importance.)

Table 1. Surface-water and groundwater sampling sites and station numbers at the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York.

Surface water sites	
Station number	Station name
04219979	Brinningstool Creek at Wheatville, NY
042199H97	Oak Orchard Creek near Wheatville, NY (Knowlesville Road)
0421999720	Oak Orchard Creek Tributary near East Shelby, NY
0421999750	Oak Orchard Creek Tributary at Roberts Road near Alabama, NY
04219998	Oak Orchard Creek at SR63 near West Shelby, NY (NYS Route 63)
04219999	Oak Orchard Creek Tributary near Shelby, NY
04220045	Oak Orchard Creek near Shelby, NY (Harrison Road)

Groundwater sites - wells			
County number	Site number	Site location name	Geologic unit monitored
GS244	430721078221401	Sour Springs Road	Lacustrine sand and gravel
GS245	430732078221001	Oak Orchard Creek well pair	Lower unconsolidated sediment
GS246	430732078221002	Oak Orchard Creek well pair	Upper unconsolidated sediment
GS286	430720078221501	Sour Springs Road	Lower Lockport Dolomite
GS287	430643078241501	Refuge Office well	Lacustrine sand and gravel
GS288	430720078221502	Sour Springs Road	Upper Lockport Dolomite
GS294	430635078345501	Casey Road	Lacustrine sand and gravel
OL25	430931078214201	Proposed quarry	Lockport Dolomite
OL27	430924078241301	Dunlap Road	Upper Lockport Dolomite
OL28	430938078220601	Fletcher Chapel Road	Lacustrine sand and gravel
OL29	430943078222301	Fletcher Chapel Road	Lockport Dolomite
OL30	430954078205301	Fletcher Chapel Road	Unconsolidated sediment - dug well
OL31	430957078203801	Fletcher Chapel Road	Lacustrine sand and gravel
OL32	430758078250201	Feeder Canal well pair	Lower unconsolidated sediment
OL33	430758078250202	Feeder Canal well pair	Upper unconsolidated sediment
OL37	430852078221101	Oak Orchard Ridge Road	Lower Lockport Dolomite
OL38	430755078271301	Salt Road	Upper Lockport Dolomite
OL39	430826078213701	Job Corps Center	Upper Lockport Dolomite
OL40	430828078214101	Job Corps Center	Upper Lockport Dolomite
OL41	430852078221102	Oak Orchard Ridge Road	Upper Lockport Dolomite
OL42	430924078241302	Dunlap Road	Lower Lockport Dolomite

Groundwater - springs			
County number	Site name	Site location name	Geologic unit monitored
GS290	Spriing #1	Oak Orchard Acid Springs	Lacustrine sediments
GS291	Spriing #2	Oak Orchard Acid Springs	Lacustrine sediments
GS292	Spriing #3	Oak Orchard Acid Springs	Lacustrine sediments
GS293	Spriing #4	Oak Orchard Acid Springs	Lacustrine sediments
OL43	430933078243001	Sulfur Spring	Lacustrine sediments
OL44	430938078243001	Fresh water Spring	Upper Lockport Dolomite

Geology

The bedrock in this part of western New York includes Upper Silurian (Lockport Dolomite) to Middle Devonian (Onondaga Limestone) strata that are roughly 400 million to 350 million years old and comprised mostly of shale between two units of carbonate bedrock. The stratigraphic column for western New York showing former and current nomenclature, specifically the units between the Rochester Shale and the Lockport Dolomite, is presented in figure 4. The bedrock sequence, originally laid down in horizontal beds in a shallow inland sea, has been modified by plate tectonics and other geologic processes, and now these bedrock units gently dip to the south-southeast at about 40 to 50 feet per mile. Repeated glacial ice advances and retreats have resulted in modification to the bedrock surface and variable thicknesses and types of glacial and post-glacial sediments that cover most of the region.

Bedrock Geology

The surficial bedrock in the vicinity of the Refuge is Vernon Shale and Lockport Group of Silurian age. The bedrock units generally lie in east-west bands with the Lockport Group lying in the northern and central part of the study area and with the Vernon Shale lying just south of the Refuge, with Onondaga Limestone of Devonian age cropping out several miles further to the south. The nomenclature for the description of Lockport and Clinton Groups used in this report is that of Brett and others (1995).

The deepest unit drilled during this study is the Clinton Group, and just the upper part of the Burleigh Hill Member of the Rochester Shale was penetrated (fig. 4). Overlying the Rochester Shale is the DeCew Dolomite, which is also part of the Clinton Group. Above the Clinton Group is the Lockport Group, which underlies most of the Refuge. The Lockport Group consists of about 160 feet of massive to medium-bedded argillaceous (shaley) dolomite with minor amounts of dolomitic limestone and shale (Brett and others, 1995, p. 45). The Lockport Group is subdivided into four formations, starting from the bottom: the Gasport Dolomite, the Goat Island Dolomite, the Eramosa Dolomite, and the Guelph Dolomite. From the bedrock cuttings recovered during the drilling of the USGS test holes and the subsequent borehole geophysical testing of each test hole, the Goat Island and Eramosa units were present in all test holes, whereas the lower part of the Guelph Dolomite through the remaining Lockport sequence is present in the Sour Springs Road test hole.

Overlying the Lockport Group is the Upper Silurian Salina Group, which is comprised of the Vernon Shale, the Syracuse Shale, and the Camillus Shale. Along the southern boundary of the Refuge, the Vernon Shale unit is likely present, whereas farther to the south, the upper units (Syracuse and Camillus) begin to crop out near land surface. Overlying the Salina Group, the Akron Dolomite of the Salina Group generally crops out south of Oakfield, N.Y. (fig. 1). Finally, south of Oakfield, N.Y., the Onondaga Limestone of Middle Devonian age is present and forms a subtle escarpment in the area. There is an unconformity (erosional surface) typical of this part of New York State, whereby Lower Devonian-aged bedrock is not present between the Salina Group and the overlying Onondaga Limestone.

Glacial Geology

New York was repeatedly covered by continental ice during the past 2.5 million years (Teller, 1987). The advance of major ice sheets scoured away soil and vegetation then began to erode the underlying bedrock. The results of this erosion left the glacial ice mass heavily loaded with sediment that was eventually deposited as glacial "drift" as the ice mass melted and receded. The most recent glacial period (Wisconsinan) reached its glacial maximum about 21,000 years ago (Michelson and others, 1983; Stone, 1995) and covered most of New York with ice.

During the last recession of Wisconsinan glacial ice in the western part of New York, several "short-term" ice readvances left additional glacial deposits, such as small, local, recessional moraines, some of which contain (or are part of) beach ridges that formed in shallow proglacial lakes. Between these ridges, lacustrine silt and clay settled out of the turbid glacial waters to the lake bottom.

Successive proglacial lakes developed in the Lake Erie basin, as much of the glacial waters drained to the west and the Mississippi River. As the glacial ice continued to melt back to the north, eastward drainage developed into Glacial Lake Tonawanda (Cadwell, 1988), which discharged to Glacial Lake Iroquois (a progenitor of Lake Ontario). Glacial Lake Tonawanda (fig. 5) developed in a glacially-excavated trough within the erodible Salina Group, between the Onondaga Limestone and Lockport Dolomite Escarpments.

Initially Glacial Lake Tonawanda drained through an outlet at Holley, N.Y. (fig. 5), but the land surface slowly rose in response to the ice front receding to the north. Therefore, the Holley outlet was abandoned as the surface area of the lake shrank back to the west. The next lake outlet formed at Medina, N.Y., with a secondary channel located at present-day Middleport, N.Y. (fig. 5). The Medina outlet channel is the present-day location of Oak Orchard Creek where it drains north over the Lockport Escarpment. Continued glacial recession and land-surface rebound further reduced the elevation and extent of Glacial Lake Tonawanda, as three additional outlets for the lake —at present day Gasport, N.Y., then Lockport, N.Y., and finally at Lewiston, N.Y.—developed toward the west. The lake then disappeared entirely as Lake Erie drained through the Niagara River gorge, to a lower level of Glacial Lake Iroquois, which subsequently became Lake Ontario.

Wetland areas in the study area, including the Oak Orchard Creek wetland and farther to the south and west the

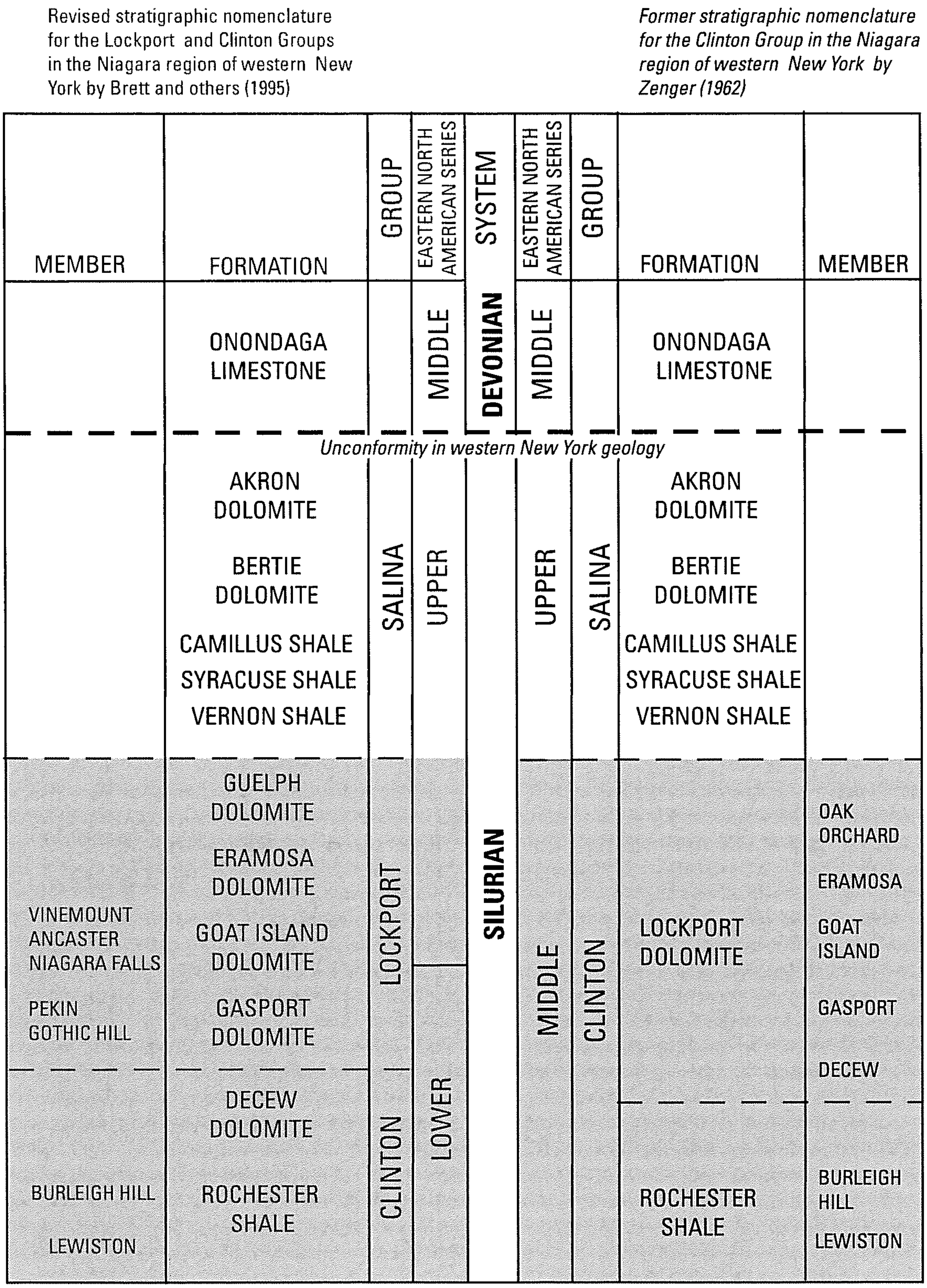


Figure 4. Stratigraphic columns for the western part of New York State showing the summary of geologic units near the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York. Stratigraphic nomenclature for the Clinton Group in the Niagara region of Western New York is by Zenger (1962). Changes in nomenclature (in red) for the Clinton and Lockport Groups are by Brett and others, (1995).

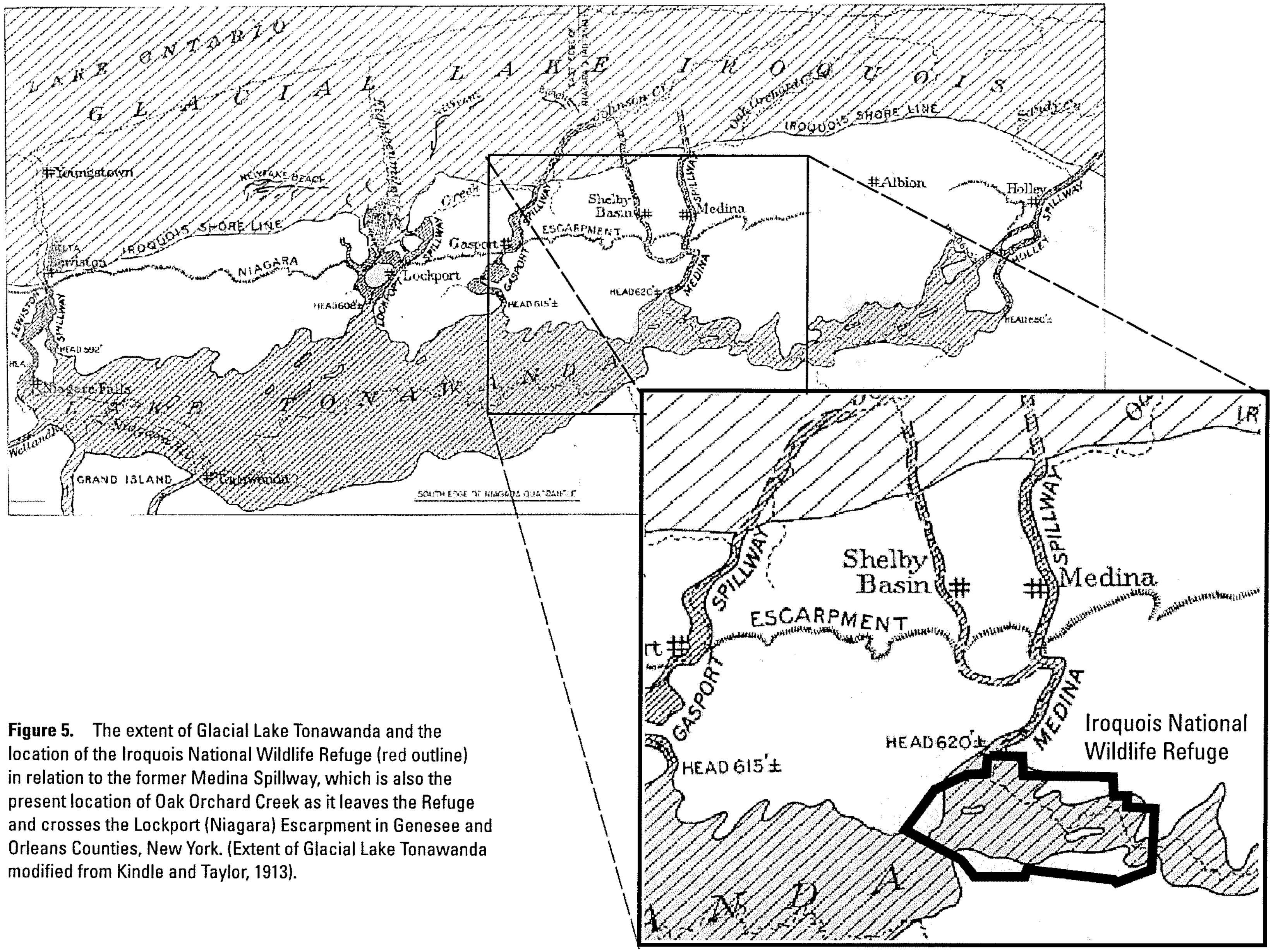


Figure 5. The extent of Glacial Lake Tonawanda and the location of the Iroquois National Wildlife Refuge (red outline) in relation to the former Medina Spillway, which is also the present location of Oak Orchard Creek as it leaves the Refuge and crosses the Lockport (Niagara) Escarpment in Genesee and Orleans Counties, New York. (Extent of Glacial Lake Tonawanda modified from Kindle and Taylor, 1913).

Tonawanda Creek wetland, are underlain by silt and clay deposited in Glacial Lake Tonawanda. Upland areas are former beach ridges and small moraines and are now generally forested or support modest residential development; the intermediate lands are gently sloping and used primarily for agricultural purposes.

Water Resources

The surface-water resources of the Refuge include Oak Orchard Creek, its tributaries, and the adjacent wetlands that are managed by the Refuge and NYSDEC. The groundwater resources include the unconsolidated and bedrock aquifers. Understanding the interconnection within and between the surface-water and groundwater flow systems is critical to the management of the Refuge and the development of their 15-year conservation plan.

Surface-Water Flow System

The surface-water flow system of the Oak Orchard Creek, its tributaries, and wetlands is primarily driven by precipitation and surface runoff, and to a lesser extent, groundwater discharge as baseflow to the streams and wetlands. Depending on antecedent water levels within and upgradient from the Refuge, the New York State Oak Orchard WMA, and the agricultural areas farther up in the watershed, the amount of water flowing into and out of the Refuge can vary based on the management of water levels in the State and Federal wetland-management units and the upgradient agricultural areas. Depending on management activities in the Refuge and farther upstream, a large amount of water flowing in Oak Orchard Creek can be diverted into or out of these wetlands, altering the amount and timing of flow entering and leaving the Refuge.

During the spring runoff, flow in Oak Orchard Creek and its tributaries is derived from snowmelt runoff, early spring rainfall, and a modest amount of shallow groundwater discharge from scattered upland sand and gravel deposits. During the spring 2009 runoff period, flow at the three Oak Orchard Creek sites averaged about 800 cubic feet per second (ft^3/s) or about 7 cubic feet per second per square mile ($ft^3/s/mi^2$) of the watershed.

Water-quality data (appendix 1) substantiate the composition of water in Oak Orchard Creek as both surface water and groundwater. The quality of water during the spring, as measured by the carbonate-to-sulfate ratio, indicated a predominant carbonate excess (more carbonate than sulfate) in the runoff that most likely comes from additional groundwater discharge from the Onondaga Limestone Escarpment, which has more carbonate than water flowing from the Salina Group Shale bedrock unit.

Following spring runoff and the establishment of wetland management-pool levels, water levels within the wetlands remain fairly steady until the wetland vegetation breaks dormancy and the evapo-transpiration (ET) process begins. Once air temperatures rise and wetland plants are fully leafed-out, the rate of ET will usually be greater than the amount of precipitation that falls in this part of New York State. Subsequent wetland water levels may fall slowly, especially if a wetland is not hydraulically connected to Oak Orchard Creek or a tributary stream. Furthermore, groundwater discharge (water moving slowly upwards through the fine-grained lacustrine sediments into the overlying organic soils) is quite slow and will not keep up with the rate of ET.

During the summer, flow in Oak Orchard Creek and its tributaries decrease because ET increases and precipitation decreases. During this period, the wetlands have reduced hydrologic interaction with Oak Orchard Creek as flow along the entire length of the Creek within the Refuge is generally confined within the banks of the creek and does not interact with adjoining wetlands. On July 19, 2010, the average flow measured in Oak Orchard Creek at the three creek sites (Knowlesville Road in the east, Route 63 in the central, and Harrison Road in the northwest) was about 20.5 ft^3/s or about 0.16 $ft3/s/mi^2$, or about 2 percent of the peak flow measured in spring 2009. Correspondingly, on September 17, 2010, the average flow in Oak Orchard Creek at the three sites was about 15 ft^3/s or about 0.12 $ft^3/s/mi^2$. The very low rate of flow measured on these 2 days across the Refuge indicates that groundwater discharge to the surface-water system within the Refuge is low and is likely lost through wetland ET. When looking at the carbonate-to-sulfate ratio in Oak Orchard Creek during low-flow conditions, sulfate enrichment over calcium is observed (opposite of the spring ratio), which indicates that the low flow in Oak Orchard Creek is more likely derived from small amounts of seepage from adjacent wetland areas and even less groundwater discharge from the underlying Salina Group and Lockport Dolomite bedrock.

The transition to cooler fall temperatures, decreased ET, and increased precipitation causes greater surface-water flow and groundwater discharge, which fills the channel of Oak Orchard Creek and its tributaries and allows the adjacent wetlands to again interact with the creek. Because groundwater levels are lowest at this time of the year, the Oak Orchard Creek system is dominated by surface-water runoff and precipitation that falls directly on the watershed and wetland areas. Discharge of groundwater to the surface-water-flow system, be it to the tributaries or the main stem of Oak Orchard Creek, continues to be small. The degree of wetland/stream interaction depends on how the wetland units are managed and the variability of seasonal climate conditions.

Groundwater-Flow System

The groundwater-flow system in and around the Refuge is comprised of a glacial, unconsolidated aquifer, underlain by a bedrock aquifer. Within the glacial sediments, there are lenses of sand and gravel that sit directly over bedrock, whereas in nearby locations, the sand and gravel is absent and only fine-grained sediments (clays, silts, and silty sands) are present. On top of the fine-grained sediments, some of the beach ridges are covered by permeable sand and gravel deposits that may be till-cored moraines. Each type and combination of glacial sediments mentioned above has various hydraulic characteristics that contribute to the overall volume, timing, and direction of groundwater flow within the regional aquifer system (fig. 6). Also, the mineralogy of the deposits through which the groundwater moves and the interaction with various land uses (wetlands to agriculture to forest) can affect the quality of water.

Groundwater levels were determined during this study from wells within and near to the Refuge and from water-level data derived from the NYSDEC Water Well Reporting Program for areas outside the Refuge boundary. These data allowed the development of a regional water-table map for wells in both the unconsolidated and bedrock aquifers (fig. 6); as these data were collected in the two aquifers at various times during the past several decades, this map can only be considered a generalized depiction of the regional water-table configuration. The regional map indicates that water levels are highest south and east of the Refuge and become progressively lower to the north and west. This pattern follows, for the most part, the elevation change from the Onondaga Limestone Escarpment to the south (at an elevation of approximately 900 feet) to the Lockport Dolomite Escarpment north of the Refuge (at an elevation of approximately 625 feet). Groundwater flow appears to follow the general trend of the east-to-west dipping bedrock trough between the two carbonate escarpments (fig. 7) but groundwater-level information for areas farther to the west is not available to determine whether there are possible outlets for groundwater flow northward toward the escarpment or southwestward toward Tonawanda Creek or a combination of the two.

Unconsolidated Aquifer

The unconsolidated sediments within the Refuge form aquifers that are unconfined to semiconfined. Data collected from two very-shallow well pairs—one along Oak Orchard Creek (GS245 and GS246) and the other along the Feeder Channel (OL32 and OL33; fig. 2)—indicate a small, upward gradient, approximately a tenth of a foot difference in water level (hydraulic head) between the deeper and shallower wells, with a distance of about 6 feet between the well screens (appendix 2, hydrographs P and Q). Along Sour Springs Road, south of Oak Orchard Creek, the water-level elevation in a homeowner-well finished in a lens of sand and gravel at the bedrock surface (GS244) is higher than the water-level elevation of water in the shallow well pair along Oak Orchard Creek (GS245 and GS246). These different water levels indicate a 4-foot upward gradient from the sand and gravel lens deposit overlying bedrock, up through the finer-grained unconsolidated sediments in which the Oak Orchard Creek well pair are finished, over a distance of about 48 feet between the deeper and shallower wells. A slight upward gradient is present within the very-shallow well pair (appendix 2, hydrograph G for the sand and gravel well, hydrograph N for the shallow well, and hydrograph O for the deep lacustrine well).

Bedrock Aquifer

The Salt Road well (OL38) on the west side of the Refuge did not yield measurable water from just below the bedrock surface down to the top of the Rochester Shale. It is not uncommon to drill a "dry hole" in the bedrock of upstate New York, although it is more common in shale than in carbonate rock, which typically has water-bearing bedding planes. Water entering the Salt Road well comes from the weathered and fractured bedrock surface and a small sand and gravel lens lying on top of the bedrock. Water that entered the well at the base of steel casing (top of bedrock was at a depth of 70 feet) at the time of drilling filled the well over several hours, coming to equilibrium at about 30 feet below land surface. The water levels at Salt Road (OL38; appendix 2, hydrograph C) from November 2008 to October 2010 fluctuated in a manner similar to that of other bedrock and unconsolidated wells across the region.

Water levels in the bedrock wells finished with upper and lower bedrock monitoring zones that indicate two different water-level relations. Each well pair—Sour Springs Road (GS245 lower bedrock and GS246 upper bedrock), Oak Orchard Ridge Road (OL37 lower bedrock and OL41 upper bedrock), and Dunlap Road (OL42 lower bedrock and OL27 upper bedrock)— was separated into two monitoring zones on the basis of the location of water-bearing zones detected by borehole geophysics at each well (appendix 3, figs. A through D). In the Dunlap Road and Sour Springs Road well pairs, the gradient between the lower bedrock zone and upper bedrock zone indicated upward movement of water in the bedrock because the water level in the lower zone was consistently higher than that in the upper zone. The head difference was about 4 feet, on average, at the Dunlap Road wells during the period of measurement and about 2 feet, on average, at the Sour Springs Road wells. The well pair at Oak Orchard Ridge Road had the opposite hydraulic head gradient than the other well pairs—the water level in the upper zone was, on average, about 4 feet higher than the water level in the lower zone, indicating a downward gradient for groundwater flow. The reason for the downward hydraulic-head gradient at Oak Orchard Ridge Road could be (1) the well was not drilled deep enough and (or) the packer was not placed deep enough to isolate a lower bedding plane with a higher head, (2) the open test holes for the proposed quarry just north of the Oak Orchard Ridge Road well could be locally affecting the head relation in the Oak Orchard Ridge Road wells, or (3) the production wells at the Iroquois Job Corps Center (OL39 and OL40; fig. 2) might be affecting the hydraulic-head relation. To eliminate one of the possibilities, the two zones at Oak Orchard Ridge Road wells were closely monitored during the

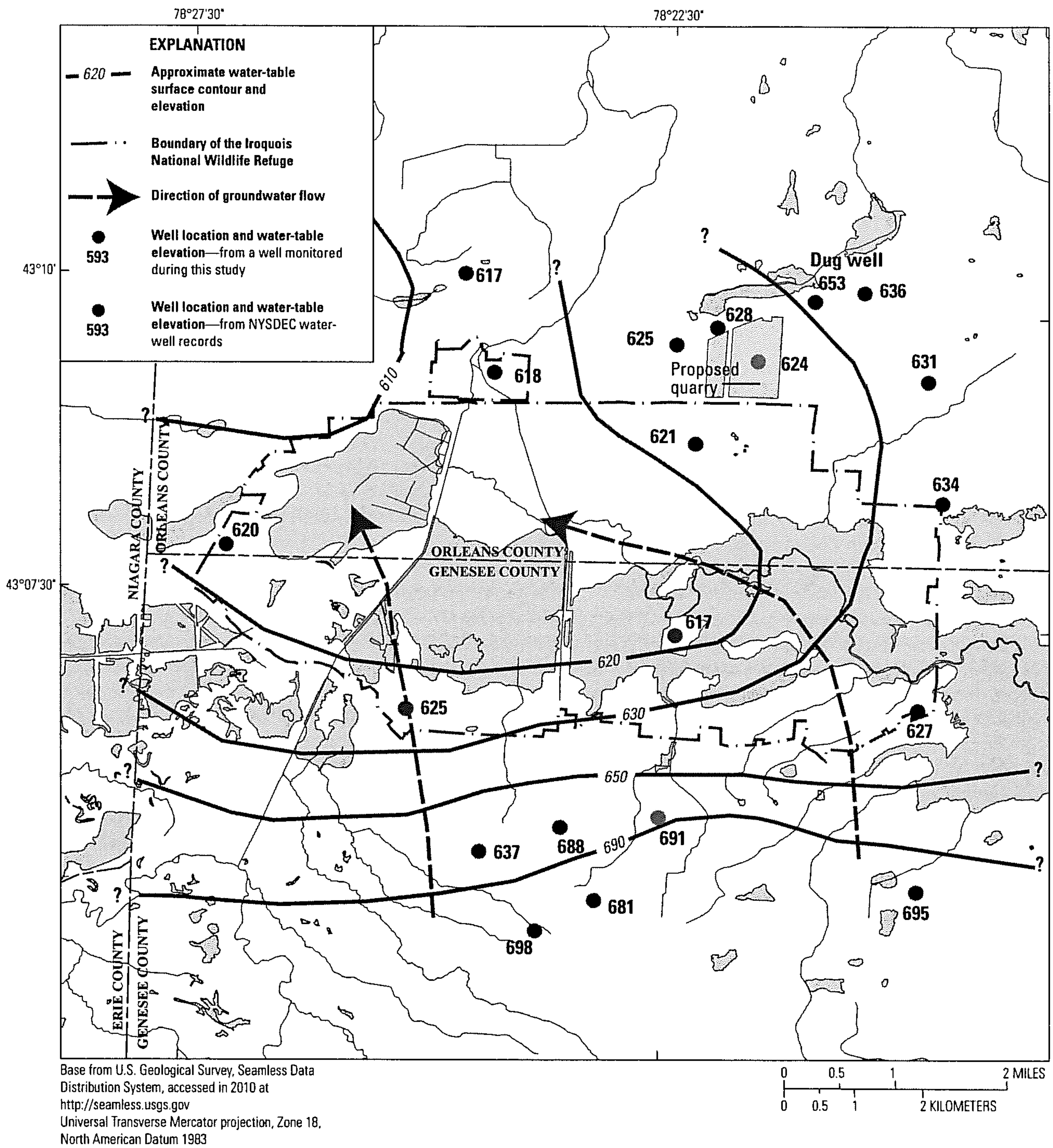


Figure 6. Approximate water table and the general direction of groundwater flow in the unconsolidated and bedrock aquifers in the vicinity of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York. Elevations are in feet. (NYSDEC, New York State Department of Environmental Conservation).

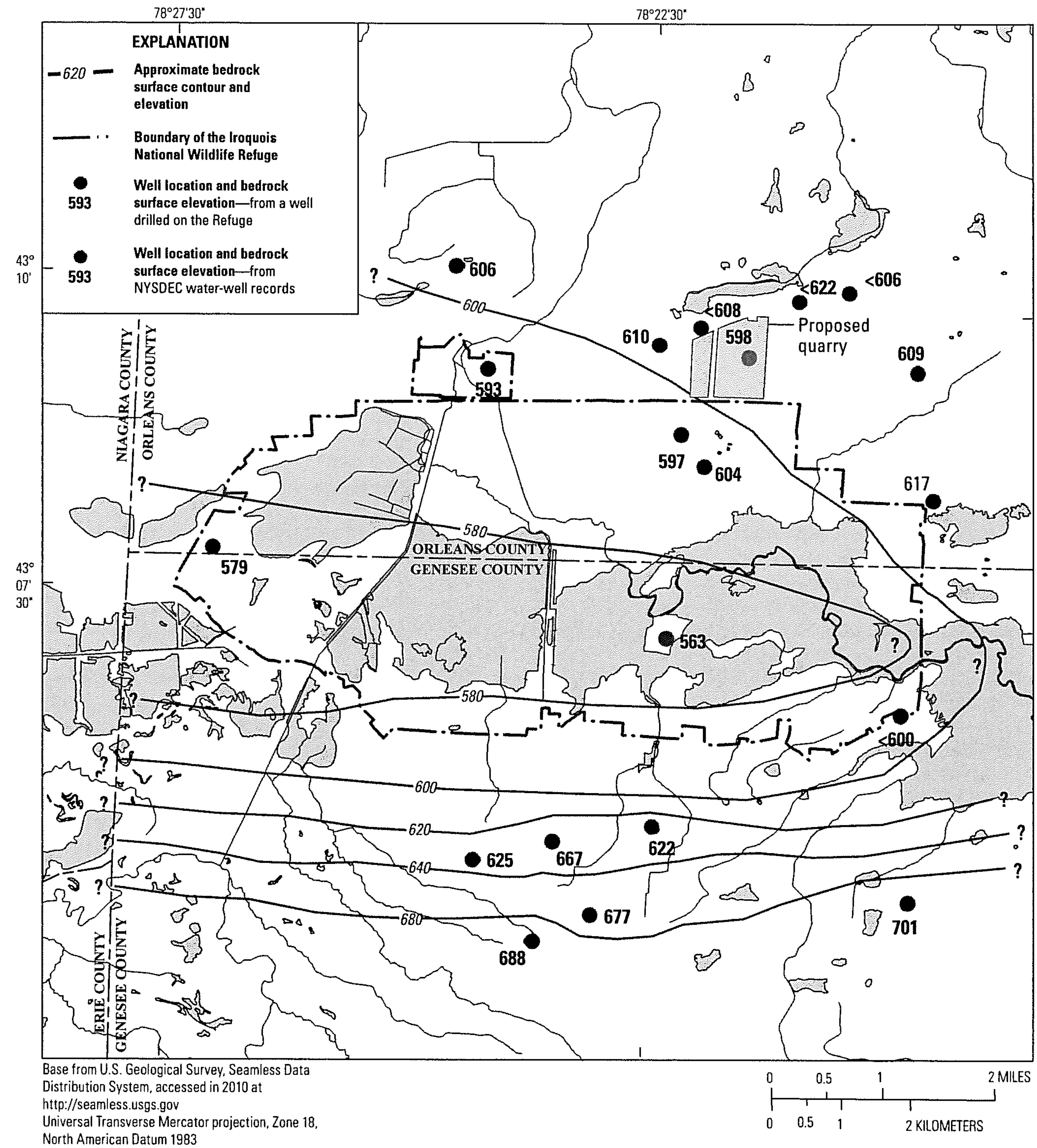


Figure 7. Approximate bedrock-surface contour and elevation in the vicinity of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York. Elevations are in feet. (NYSDEC, New York State Department of Environmental Conservation).

winter and summer vacation periods at the Job Corps Center, when water use is greatly reduced. No perceptible change was noted in the Oak Orchard Ridge Road wells monitoring zones and therefore, one or both of the two remaining theories may indicate the conditions affecting the head gradient at this location.

Well Hydrographs

Water-level fluctuations in 17 wells, including unused homeowner wells were monitored throughout the Refuge area (appendix 2). One dug well (OL30) north of the Refuge on Fletcher Chapel Road was also monitored (appendix 2, hydrograph A). The annual water-level fluctuation was almost 20 feet. The well was responsive to spring recharge and showed a slow water-level decline during the summer; water levels for this well during summer 2010 were not collected due to equipment malfunction.

Water-level fluctuations varied depending on the aquifer monitored and the topographic position of the well. In four wells that tap an apparently discontinuous layer of sand and gravel that overlies bedrock (GS244, GS294, OL28, and OL31), water-level fluctuations during the 2-year monitoring period ranged from 3 to 8 feet. In the four wells finished in the upper Lockport Dolomite bedrock (GS288, OL41, OL27, and OL38), water-level fluctuations ranged from 3 to 6 feet, whereas in three wells finished in the lower Lockport Dolomite bedrock (GS286, OL37, and OL42), water-level fluctuations ranged from 4 to 8 feet. The amount of fluctuation varied depending on the topographic position of the wells. Those closest to the creek and lowest in land-surface elevation varied the least; those farther from the creek and at higher elevations varied the most over the 2 years of monitoring.

The water levels in two well pairs located along Oak Orchard Creek (GS245 and GS246) and the Feeder Channel (OL32 and OL33) fluctuated by about 4 feet and 1 foot, respectively. The water-level fluctuations for these well pairs reflect the interactions of the well pairs with those in the nearby surface-water body; the water level at the Feeder Channel is generally maintained at a prescribed management level, whereas the water level at Oak Orchard Creek is minimally regulated at the downstream end of the Refuge, several miles away from this second well pair. The shallower well in each pair also fluctuates more, albeit by only an additional 0.5 foot. This was most likely related to the fluctuation in the nearby stream, such as spring flooding of the marsh, which overtopped the land surface at both well sites. These wells indicate that, while the local groundwater gradient is upward in the fine-grained lacustrine soils, the rate of flow is likely small because the rate of change in the upper zone when overwhelmed by the water level of the adjacent water body is not transferred to the lower zone immediately.

The annual pattern of water-level fluctuation in the wells monitored in this study is affected by (1) the topographic position of the well in the Refuge area (land-surface elevation and proximity to the wetlands) and (2) the regional groundwater response to seasonal changes in precipitation and recharge. Wells on the north side of the Refuge (Fletcher Chapel and Dunlap Road areas, fig. 2) that receive water from either the upper bedrock or the sand and gravel just above the bedrock reflect regional water-level fluctuations, especially where the bedrock or sand and gravel lens is close to land surface. Results of a comparison of well hydrographs from Fletcher Chapel and Dunlap Road wells in the northern part of the Refuge with those from a Lockport Dolomite well located about 25 miles to the west of the Refuge (Niagara County well NI869, fig. 1) indicate a regional pattern of fluctuation as opposed to a local pattern (appendix 2, hydrographs D, E, F, and R). Water levels in wells on the southern and western side of the Refuge that have a greater thickness of unconsolidated deposits and are closer in elevation to the wetlands appear to follow a diminished seasonal water-level fluctuation that is not as greatly affected by rapid recharge of surface water to groundwater.

Natural Gas Discharges

Water-level fluctuation in the lower Lockport Dolomite zone of the Sour Springs Road (GS286) and Oak Orchard Ridge Road (OL37) wells (appendix 2, hydrographs I and K, respectively) are similar to those in their upper Lockport Dolomite companion zones (wells GS288 and OL41, appendix 2, hydrographs H and J, respectively). However, the lower zones display a greater amount of fluctuation due to the presence of natural gas (methane and hydrogen sulfide) exsolving (coming out of solution) from the water in the lower bedrock zone of these two test holes. The discharge of natural gas makes the water level fluctuate rapidly (making a "boiling" noise in the well) as the natural gas bubbles-up and out of the water column. This discharge causes the well hydrograph to have a "painted" appearance rather than a smooth line as seen in most of the hydrographs in appendix 2. In contrast, the lower zone of the Dunlap Road (OL42) well (hydrograph M in appendix 2) does not exhibit this "painted" pattern because the Lockport Dolomite in this location is at a higher elevation and does not have a gas discharge; most likely any gas that might have been present has migrated out of the bedrock through bedding-plane and other fractures to the nearby Lockport Dolomite Escarpment. The Salt Road well (OL38, hydrograph C in appendix 2) exhibits an intermittent natural-gas response, as, during drilling, the smell of hydrogen sulfide gas was present, but disappeared quickly as the well filled with water. The hydrograph for the Salt Road well does display periods where the hydrograph has a "painted" appearance, and at times, a low rate of bubbling can be heard in this well.

Bedrock Aquifer Response at Local Lockport Quarries

One of the concerns in the long-term planning process for the Refuge is the possible effects of the development of a bedrock quarry along the northern border of the Refuge, east of Sour Springs Road (fig. 2). The quarry may be more than 120 feet deep, and during dewatering operations, which might need to occur year round, large quantities of groundwater (Continental Placer, 2008) of unknown quality, could be discharged to wetlands in the northern part of the Refuge. To assess the possible effects on the Refuge, two nearby Lockport quarries were visited, and discussions with the quarry managers were held in 2009.

Northwest of the Refuge is the Shelby Crushed Stone quarry, and to the northeast is the Barre Stone Products quarry (fig. 1). Both quarries mine the lower extent of the Lockport Dolomite Group; the Gasport and DeCew Formations are mined in the Shelby quarry. Although visits were made to both quarries, only the Shelby Crushed Stone quarry supplied detailed stratigraphic and hydrologic information. The proposed quarry north of the Refuge would be farther south of the other quarries and would intersect more of the Lockport Dolomite Group if mining proceeded there; the Eramosa Dolomite (formerly the lower part of the Oak Orchard Dolomite) and all the Goat Island, Gasport, and DeCew Dolomites (Continental Placer, 2008).

Groundwater inflow to the Shelby and Barre quarries occurs along bedding planes at the quarry walls, generally in the southern half of each quarry. Groundwater-discharge rates seasonally vary from several hundred to several thousand gallons per minute according to the quarry managers. However, there is an unknown amount of water that reenters each quarry through leakage of discharge pipes and channels, and therefore, an accurate assessment of groundwater discharged from these quarries could not be made. Groundwater quality has not been extensively tested at either quarry, but the water flowing from the quarry walls appears to be fresh and probably has a quality similar to that from the Dunlap Road bedrock well because the quarries and the Dunlap Road well are close to the Lockport Dolomite Escarpment. A testhole drilled into the Rochester Shale on the floor of the Shelby quarry yielded sulfate-rich "black water." This type of water quality was found in the Oak Orchard Ridge bedrock well, which is located about a half mile southwest of the proposed quarry. Natural gas (hydrogen sulfide and possibly methane) is seasonally present in both quarries, but only the smell of hydrogen sulfide has been noted at times (methane has no odor), and the amount of gas has not been a concern for the quarry managers.

Water levels are monitored at the Shelby quarry in open bedrock holes near the quarry walls and at several homes distant from the quarry. Homes several hundred feet east and west of the quarry have not lost or noted changes in their water supplies, but homeowners south of the quarry have reported changes in their water supplies; these changes have not been confirmed. Groundwater studies at other Lockport Dolomite quarries report modest decreases in water levels near active Lockport quarries (Gowan, 1988; Continental Placer, 2008). but according NYSDEC, other studies documented that drawdowns have occurred near Lockport Dolomite quarries at distances of as little as 50 feet from a quarry wall to as far as 1,200 feet (D.L. Bimber, New York State Department of Environmental Conservation, written comm., December, 2009). A USGS study in the Niagara Falls area (Miller and Kappel, 1987) noted that the construction and operation of the Niagara Power Project, where major excavations into the Lockport Dolomite occurred, did affect groundwater levels at distances up to one-half mile from the bedrock excavations.

In comparison to the above water-level drawdown assessments in Lockport Dolomite quarries, another USGS study near an Onondaga Limestone quarry (Staubitz and Miller, 1987) noted that groundwater levels experienced greater water-level decline at greater distances from an Onondaga Limestone quarry than those observed in Lockport Dolomite quarries. Groundwater-level fluctuations also differ between Onondaga Limestone and Lockport Dolomite quarries as shown in the annual hydrographs in appendix 2. Groundwater fluctuations in Lockport Dolomite wells (appendix 2, hydrographs H, J, or L) are about half of those in well GS217, which is drilled into the Onondaga Limestone (appendix 2, hydrograph T). The greater range in groundwater-level fluctuation reflects a greater degree of permeability and hydraulic connection in the limestone bedrock rather than in dolomite bedrock.

The effects of development of any bedrock quarry and the effects of dewatering the quarry on local water resources will depend on (1) the type of bedrock being quarried, (2) how well developed the groundwater-flow system is within the bedrock sequence, and (3) the relative position of the quarry in the regional groundwater-flow system. In regard to number two above—a well-developed fractured-rock flow system would more likely be present in highly solution-prone limestone bedrock, as compared to less soluble dolomitic bedrock. In relation to number three above—regarding relative position, if a quarry is located relatively high in the regional topography, where groundwater would be flowing away from the quarry, water-level drawdown during dewatering would be less than that for a quarry located in a low-lying area, where groundwater would naturally flow toward the quarry. The quarry at the lower elevation would most likely experience greater groundwater-level decline and a greater volume of water having to be discharged during annual dewatering operations. The proposed quarry site on the north side of the Refuge is located in the (lower elevation) hydrologic position.

Water Quality

The quality of water within and below the Refuge depends on the source and the flowpath taken as water moves through the Oak Orchard Creek watershed. Surface water is affected by precipitation and flow through the soils and shallow glacial deposits. Any anthropogenic activity at or below the soil surface can alter the quality of surface water or groundwater as it moves through the wetlands upstream from and within the Refuge. Any interaction with groundwater that discharges to the surface-water system can also affect the surface-water system. Water-quality changes in either the surface-water or groundwater system are dependent on the flowpath taken, be it shallow through the soils and glacial deposits, slightly deeper through the upper Lockport Dolomite bedrock aquifer, or through a deeper bedrock aquifer, such as the Salina Group Shale further to the south.

Surface Water

Results of the surface-water-quality analyses for Oak Orchard Creek and several of its tributaries within the Refuge are consistent with others for this part of New York. The pH of surface water is nearly neutral with a median of about 7.2. The specific conductance of the water ranges from 200 to 2,000 microsiemens per centimeter (µS/cm) at 25 degrees Celsius with the smaller tributaries having slightly less conductance. There is a slight downward trend in specific conductance along Oak Orchard Creek as it flows through the Refuge from east to west.

Nutrient concentrations in samples from Oak Orchard Creek were slightly elevated, which is not unusual for a watershed with areas of major agricultural land use above the Refuge (Makarewicz and Lewis, 2009). Concentrations of various forms of phosphorus and nitrogen are somewhat elevated from natural background conditions, but not as elevated as the concentrations in water discharged to Oak Orchard Creek upstream from the Federal and State WMAs (Makarewicz and Lewis, 2009). Inorganic constituent concentrations (metals such as magnesium, lead, iron, and zinc; appendix 1) are somewhat greater than what would be considered background levels in most of New York State, but this condition might be related to the quality of water discharged from bedrock, such as the Lockport Dolomite and Salina Shale units, up through glacial sediments to Oak Orchard Creek.

Groundwater

Groundwater quality is highly variable in the region surrounding the Refuge. The quality of groundwater south of the Refuge is poor because it interacts with minerals present within the Salina Group that impart a strong sulfur taste and smell to the water and because it interacts with trace metals and halite (sodium chloride). The slow movement of water in shales of the Salina Group causes trace metal concentrations to increase and therefore results in limited availability of potable water (Bill Frey, Frey Well Drilling, April 2009, oral commun.). Any fresh water found in wells is usually found at the shallowest depths and might require some sort of treatment before it can be used for drinking water or other residential uses.

In the central part of the Refuge, roughly east-west along the Genesee-Orleans County line, the quality of water from bedrock does not improve as the depth to bedrock increases; flow from bedrock bedding planes and fractures usually leaches sulfide-bearing minerals into the slow-moving groundwater. Groundwater from the shallower bedrock generally has a mild-to-strong sulfide taste and smell; stronger sulfide concentrations are present at depth. Also at depth are various forms and quantities of natural gas, primarily methane and hydrogen sulfide gas. The presence of ferrous sulfide produces "black water," which is highly corrosive to many metals, stains clothes and skin, and makes water quite difficult to treat in order to make it potable.

Farther to the north where the Lockport Dolomite is at or near land surface, groundwater flows quickly through the bedrock fractures, and the quality and quantity of water improves. This shallow groundwater is generally quite fresh because it is in the active part of the groundwater-flow system. Even though groundwater in the northern part of the Refuge may interact with the sulfide minerals along bedrock fractures, the short contact time that the groundwater has with these minerals produces low concentrations of sulfide in this part of the groundwater system.

The water-quality data collected during this study (appendix 1) are summarized through the use of a Piper or trilinear diagram (Piper, 1944) to determine which samples have similar ionic composition that may reflect a similar source. The Piper diagram for the Refuge data (fig. 8) shows the relative percentages of major cations (calcium, magnesium, and sodium plus potassium) plotted on the lower left triangle and relative percentages of anions (chloride, bicarbonate, and sulfate) plotted on the lower right triangle. These percentages are then projected to the diamond plot above where certain data points may cluster in a common water type or show a mixing trend of different water types. The water-quality samples of the Oak Orchard Acid Springs are clustered in the upper right corner of the diamond as calcium-sulfate dominated water (see a further description of the Acid Springs below). The groundwater from the sand and gravel well (GS244) along Sour Springs Road is a sodium-bicarbonate-type water as seen on the lower part of the diamond plot, whereas the groundwater from the lower Lockport bedrock well (GS286) at Sour Springs Road is a sodium-chloride-type water. Therefore, the quality of water in the two wells differs. The two springs on the northwest side of the Refuge appear to serve as approximate chemical-mixing endpoints for both surface water and groundwater. A spring located in the Lockport Dolomite (OL44) represents a fresh, calcium-bicarbonate-type water discharging directly from the

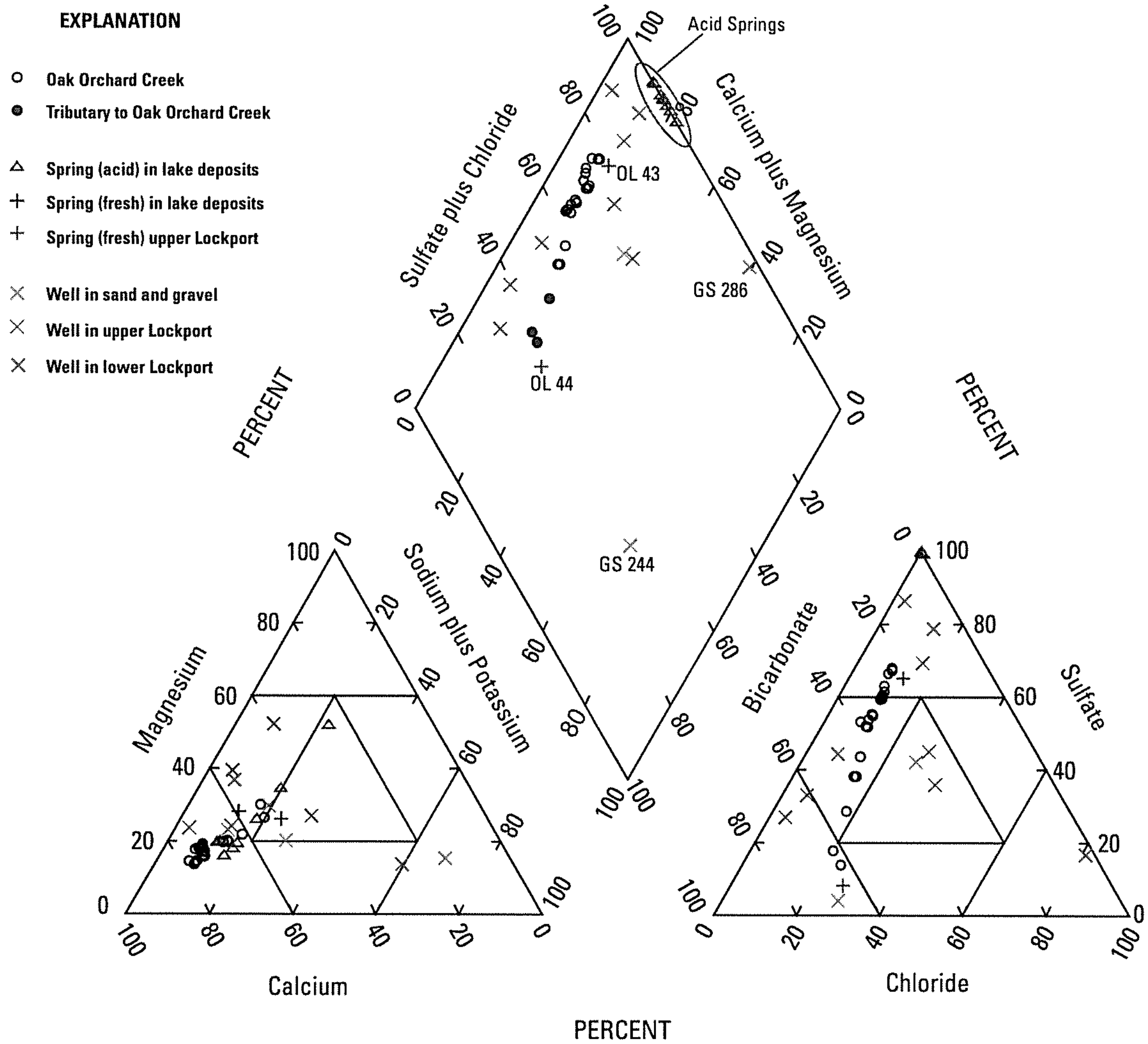


Figure 8. Piper diagram of major cations and anions in surface-water and groundwater samples collected in and around the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009–10.

bedrock at land surface, whereas the nearby Sulfur Spring (OL43) represents a calcium-sulfate-rich water discharging from lacustrine sediments, although the actual source of this water is unknown; locally, some residents speculate the water might be discharging from an old, unplugged gas well. The remaining water samples appear to align, for the most part, between these two water types.

The water types of three of the four tributary samples are close to the water quality of the OL44 endpoint (more bicarbonate than sulfate), but the water types of the remaining stream samples range from bicarbonate- to sulfate-dominated water, depending on the time of year. During high surface-water-runoff periods in the spring, the samples from Oak Orchard Creek exhibit either a bicarbonate- or sulfate-dominated ionic composition. During low-flow conditions in the summer, sulfate-type waters dominate in surface-water samples. These trends in seasonally different surface-water quality indicate that the two water types contribute to the flow in Oak Orchard Creek. The bicarbonate-type water likely originates from springs and streams discharging from the Onondaga Limestone on the south side of the watershed, generally during the spring peak-runoff period, when the sulfate-type water from the Salina Group is diluted by water from a limestone source. During summer low-flow periods, the sulfate-type water is often dominant because the discharge from the Onondaga Limestone is greatly reduced, if not totally absent.

The different sources of water were described in an independently produced Surface Water Assessment Tool (SWAT) model of the Oak Orchard Creek watershed, developed by Richards and others (2010). To have the SWAT model reproduce realistic spring-runoff volumes in Oak Orchard Creek, the model needed additional surface-water flow from outside the Oak Orchard Creek watershed to be properly calibrated; that flow was described as groundwater discharge originating from the Onondaga Limestone Escarpment. This additional flow was modeled only for the spring runoff period. Simulated flow in Oak Orchard Creek during other seasons was only from within the Oak Orchard Creek watershed, which flows across and through Salina Group shale bedrock.

Similar water-quality conditions were noted across these same bedrock units in Monroe County, N.Y., east of the study area (Hayhurst and others, 2010, p. 18). This study found that large sulfate concentrations measured in samples from Irondequoit Creek were the result of dissolution of gypsum layers found in Silurian shale (Salina Group) that crops out in that part of that watershed. Therefore, this dual-source flow system (seasonally-produced surface-water and groundwater flow from limestone and shale bedrock) produces seasonally different water quality in these watersheds and most likely elsewhere in north-central New York State where these bedrock units are present.

The Oak Orchard Acid Springs

The Oak Orchard Acid Springs are a unique feature in New York State because of their naturally low pH (about 2.0) and their location deep within the Oak Orchard Creek wetlands. Since their discovery in the early 1800s, these springs have been a source of curiosity and, for a time, a source of "medicinal healing" according to those who promoted their use. Water from the spring ponds—surface discharge from these springs was minimal during the two site visits to collect water samples—was bottled and sold throughout the East Coast and purportedly shipped to the western states and Europe (North, 1899). The springs were considered unique because each had its own type of water, "three of which are acid, one sulphur, one magnesia, one iron, and one gas spring sufficient to light 50 gas burners," according to the "History of Alabama, N.Y." (North, 1899) The water became so popular that a hotel was eventually built near the springs., but by the mid- to late 1800s, the use of the acid waters greatly declined, and the springs were all but forgotten except for the name of a nearby road—Sour Springs Road.

The quality of this acidic water from four different springs (GS290, GS291, GS292, and GS293) was initially determined in December 2009. Because of the highly unusual results (the very low pH of the water, the high trace metal content, and the nearly-constant discharge of natural gas from two springs), a confirming set of samples was collected in May 2010. Once the water quality of the springs was confirmed, an understanding of the physical and chemical processes that create this unique water quality was determined using two USGS geochemical models—NETPATH (Plummer and others, 1994) and PHREEQC (Parkhurst and Appelo, 1999)—to determine the possible geochemical processes that might create the acid spring waters (N. Plummer, U.S. Geological Survey, written commun., 2010). The most appropriate model, developed in NETPATH, identified oxidation of organic carbon and pyrite from the shales of the Salina Group, which resulted in the reduction of organic carbon to methane gas and the further oxidation of pyrite (specifically the sulfide in the pyrite, which lead to a large amount of sulfate in the discharged water). The result of all these reactions is sulfuric acid (pH of about 2.0) and dissolved methane (as mentioned in the historic account of North, 1899). The results of the water-quality analyses of water from these springs (GS290, GS291, GS292, and GS293) can be found in appendix 1.

Water-Quality Concerns and the Proposed Lockport Quarry

The quality of water that will be discharged from the proposed quarry is of concern to managers at the Refuge because of the quality of water from the Lockport Dolomite wells at Oak Orchard Ridge Road and Sour Springs Road, and because of the quality of water from the Oak Orchard Acid

Springs. The two USGS wells (GS286 and OL41) closest to the proposed quarry, contain typical Lockport "black water" (ferrous sulfide) at depth and natural gas (hydrogen sulfide and methane) discharges from these wells. The draft environmental impact statement (DEIS) for the quarry (Continental Placer, 2008) noted that "black water" and hydrogen sulfide were detected in the discharge from the pumped well (OL25, fig. 2) used during the 72-hour aquifer test conducted in 2007 (Continental Placer, 2008, p. 43). The position of the proposed quarry in a topographic and bedrock low also indicates that groundwater will most likely flow toward the quarry from all directions rather than from the south as is the case at the Shelby and Barre quarries. These active quarries are located farther to the north, higher in the regional topography, and closer to the Lockport Dolomite Escarpment where groundwater discharges are fresh water.

The possibility that poor-quality water ("black water," chlorides, trace metals, and methane and hydrogen sulfide gases) will be discharged during dewatering operations from the proposed quarry to one or more streams that drain into the Refuge is of concern to the Refuge managers. The quarry water would be discharged to Refuge wetland management areas and ultimately to Oak Orchard Creek. The rate of discharge from the quarry was stated to be from 260 to 2,250 gallons per minute [0.5 to 5.0 cubic feet per second (ft^3/s)], according to the DEIS (Continental Placer, 2008). Therefore, during summer low-flow periods, when tributary channels are normally dry and the flow of Oak Orchard Creek might be as little as 20 ft^3/s, the contribution of the quarry discharge to Oak Orchard Creek could be as small as 2 percent or as high as 20 percent of the creek's flow. Rapid surface-water infiltration to the groundwater system is not likely to occur because of the type of fine-grained deposits present in this part of the Oak Orchard Creek watershed. In addition, the Refuge managers are concerned about any change to the hydrology of the bedrock groundwater-flow system that alters the Oak Orchard Acid Springs. Drawdown from quarry dewatering operations, especially in the deeper excavation areas, could alter groundwater-flow paths to an extent that has not been determined but might affect the production of the acid waters in the springs located south of the proposed quarry.

Summary

A 2-year study of the water resources of the Iroquois National Wildlife Refuge in western New York was carried out during 2009–10 in cooperation with the U.S. Fish and Wildlife Service to assist Refuge managers in the development of their 15-year Comprehensive Conservation Plan. The study focused on surface-water resources of the Refuge, primarily Oak Orchard Creek; the groundwater resources that underlie the Refuge, primarily the Lockport Dolomite and overlying glacial deposits; and possible changes to these hydrologic systems as a result of the proposed development of a bedrock quarry along the north side of the Refuge.

Oak Orchard Creek was monitored seasonally for flow and water quality, and four tributary streams that flow only during early spring were also monitored. A continuous streamgage was operated on the creek just north of the Refuge. Four bedrock wells were drilled within the Refuge to characterize the glacial deposits and the bedrock beneath the Refuge. Water levels were monitored in 17 wells, and water-quality samples were collected from 11 of those wells, from 1 bedrock spring, and 5 springs discharging from glacial deposits.

Flow in Oak Orchard Creek is highly variable. During spring runoff, flows can be as great as 7 cubic feet per second per square mile ($ft^3/s/mi^2$), whereas during summer low flows, the discharge can be as little as 0.16 $ft^3/s/mi^2$. Oak Orchard Creek has two different source areas. During spring runoff, flow from the Onondaga Limestone Escarpment, several miles south of the Refuge supplements surface runoff and groundwater discharge from the Oak Orchard Creek watershed. To a lesser degree, the Salina Group to the south and east of the Refuge and the Lockport Dolomite on the north side of the Refuge contribute to the surface-water system. During the summer and fall low-flow period, limited amounts of groundwater discharge from the Salina and Lockport bedrock units of Oak Orchard Creek and the unconsolidated sediments supply a small amount of the flow measured in the creek during this period. Water quality in the creek is affected by the seasonal variability of the quantity and quality of water from these sources.

The Lockport Dolomite underlies nearly all the Refuge, based on the results of the drilling program for this study and information from the New York State Department of Environmental Conservation Water Well Reporting Program. Between the Lockport Dolomite Escarpment and the Onondaga Limestone Escarpment, north and south of the Refuge, respectively, a bedrock trough was gouged out by multiple glacial advances. This bedrock trough was subsequently filled with mostly fine-grained sediments. Glacial Lake Tonawanda was present following the last period of glaciation about 10,000 years ago. These fine-grained sediments became the floor of the wetlands found along Oak Orchard Creek and nearby Tonawanda Creek. Water quality in the unconsolidated and bedrock aquifers is variable, with poor quality water (chlorides, "black water," and methane gas) generally present south of Oak Orchard Creek, and better quality (fresh) water present at or near the land surface in aquifers north of the Refuge in the upper Lockport Dolomite.

The Oak Orchard Acid Springs are present within the Refuge and are considered unique in New York State. The waters in these springs generally have a pH of about 2.0, and several springs discharge natural gas, primarily methane. These springs were popular for their supposed medicinal benefits in the mid-1800s, but are now generally disregarded. The geochemistry of these springs is apparently unique and is theorized as being the result of the position of the springs

within the bedrock trough, their connection to the highly mineralized shale and possibly dolomitic bedrock, and the mineralogy of the sediments through which they flow and discharge from at the land surface.

The potential development of a bedrock quarry along the northern border of the Refuge is of concern to the Refuge managers. The construction of the quarry and the amount of water that could be discharged from the excavation may have an impact on the neighboring Refuge wetlands. The extent of drawdown from dewatering could change the local hydrology as well as the direction and rate of groundwater flow in the Lockport Dolomite. Although the effect on the flow of Oak Orchard Creek is expected to be minimal, changes to the local hydrology and water quality could affect the Acid Springs and the manner in which they function.

The greatest concern is the quality and amount of water that may be discharged from the quarry during dewatering operations. The quality of this discharge could include "black water" (ferrous sulfide), chlorides, trace metals, and natural gas (hydrogen sulfide and methane) from the lower Lockport Dolomite. The poor water quality was noted in the quarry draft environmental impact statement and has been documented from nearby U.S. Geological Survey monitoring wells. The additional flow to the Refuge from the dewatering of the quarry will affect the hydrology of any wetlands downstream from the quarry and possibly Oak Orchard Creek. During low-flow periods, the quantity of discharge from the quarry, when compared with the flow of Oak Orchard Creek, could be less than 2 percent of the Oak Orchard Creek flow, but as much as 20 percent of the creek flow. During low streamflow periods, the anticipated poor quality of the quarry water discharging into tributary channels with no flow could affect the ecology of the wetlands and the wildlife that use these wetlands.

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Appendix 1. Results of Water-Quality Analyses of Samples from Streams, Wells, and Springs in and around the Iroquois National Wildlife Refuge, November 2008 to November 2010. (Tables 1–1 through 1–10)

Table 1–1. Site information and physical properties of samples collected from springs and wells from the Iroquois National Wildlife Refuge, New York, 2009–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; (00400), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier [1]	Well depth, in feet	Geologic unit	Sample date	pH, unfiltered, field, standard units (00400)	Salinity, unfiltered, parts per thousand (00480)	Specific conductance, unfiltered, microsiemens per centimeter at 25 degrees Celsius (00095)	Temperature, water, degrees Celsius (00010)	Hydrogen sulfide, water, unfiltered, mg/L (71875)
				Springs				
GS 290	--	Lacustrine	12/2/2009	--	0.6	1,280	3.9	Present
GS 290	--	Lacustrine	5/10/2010	1.9	0.9	1,760	5.7	Present
GS 291	--	Lacustrine	12/2/2009	--	2.6	4,920	4.1	Present
GS 291	--	Lacustrine	5/10/2010	1.6	2.5	4,730	6.0	Present
GS 292	--	Lacustrine	12/2/2009	--	5.3	9,440	8.0	Present
GS 292	--	Lacustrine	5/10/2010	1.4	5.6	10,000	8.6	Present
GS 293	--	Lacustrine	12/2/2009	--	6.6	11,700	8.4	Present
GS 293	--	Lacustrine	5/10/2010	1.3	5.2	9,200	8.5	Present
OL 43	--	Lacustrine	12/2/2009	7.2	1.0	1,930	10.4	Present
OL 44	--	Upper Lockport	12/2/2009	7.0	0.3	704	10.3	Absent
				Wells				
GS 244	60	Sand and gravel	6/29/2009	9.1	0.1	222	11.6	Absent
GS 286	280	Lower Lockport	7/13/2009	6.9	11.9	14,900	10.8	Present
GS 287	60	Sand and gravel	6/29/2009	7.0	1.0	1,870	12.5	Absent
GS 288	130	Upper Lockport	6/29/2009	7.2	0.6	1,130	10.1	Present
OL 27	198	Upper Lockport	6/29/2009	7.3	0.4	718	10.1	Absent
OL 37	179	Lower Lockport	7/13/2009	9.0	1.1	2,150	10.5	Present
OL 38	240	Upper Lockport	6/29/2009	7.3	1.2	2,340	10.1	Present
OL 39	75	Upper Lockport	6/30/2009	7.1	1.2	2,310	11.7	Present
OL 40	75	Upper Lockport	6/30/2009	7.0	0.9	1,700	12.5	Absent
OL 41	100	Upper Lockport	6/29/2009	7.7	0.2	503	10.3	Absent
OL 42	90	Lower Lockport	7/13/2009	7.9	0.3	700	10.2	Absent

[1]Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

Table 1–2. Concentrations of nutrients in samples collected at springs and wells from the Iroquois National Wildlife Refuge, New York, 2009–2010.

[Site locations shown in figure 2. mg/L, milligrams per liter; N, nitrogen; P, phosphorus; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (00623), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier[1]	Ammonia plus organic N, filtered, mg/L as N (00623)	Ammonia plus organic N, unfiltered, mg/L as N (00625)	Ammonia, filtered, mg/L as N (00608)	Nitrate plus nitrite, filtered, mg/L as N (00631)	Nitrite, filtered, mg/L as N (00613)	Orthophosphate, filtered, mg/L as P (00671)	Phosphorus, filtered, mg/L as P (00666)	Phosphorus, unfiltered, mg/L as P (00665)
				Springs				
GS 290	2.1	15	0.526	0.09	0.003	0.867	1.01	1.81
GS 290	3.0	3.1	1.51	0.07	E.002	0.610	0.999	0.923
GS 291	11	13	8.49	<.04	<.002	2.06	1.78	1.83
GS 291	7.6	7.5	4.89	<.04	<.002	1.61	1.85	1.85
GS 292	3.7	7.0	0.063	<.04	E.005	1.50	1.95	2.41
GS 292	2.3	4.0	0.054	<.04	<.002	0.802	1.18	1.60
GS 293	10	12	3.18	<.04	<.002	1.69	2.00	2.13
GS 293	4.9	5.7	2.05	<.04	<.002	0.882	1.17	1.16
OL 43	0.85	1.2	0.183	0.16	0.006	0.016	0.099	0.222
OL 44	E.10	0.14	E.012	1.42	<.002	E.007	0.009	0.020
				Wells				
GS 244	E.07	E.09	<.020	<.04	<.002	<.008	<.006	0.010
GS 286	4.7	4.7	4.33	<.04	<.006	0.228	0.268	0.267
GS 287	0.13	0.15	0.071	0.15	0.020	0.011	<.006	<.008
GS 288	0.40	0.46	0.355	<.04	<.002	<.008	<.006	0.011
OL 27	E.09	0.13	0.037	<.04	<.002	0.011	E.006	0.009
OL 37	0.20	0.21	0.132	<.04	<.002	0.009	<.006	0.008
OL 38	E.10	0.19	0.056	<.04	<.002	0.010	<.006	E.006
OL 39	E.09	0.18	0.027	0.21	0.003	0.008	<.006	0.020
OL 40	0.18	0.14	0.055	<.04	<.002	0.009	E.003	E.006
OL 41	0.12	0.15	0.067	<.04	<.002	0.015	0.014	0.012
OL 42	0.17	0.14	0.106	<.04	<.002	E.007	<.006	<.008
Drinking Water Standards (a, b,c,d, or e)	--	--	--	10[a, b]	1[a, b]	--	--	--

[1]Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

[a]USEPA Drinking Water Health Advisory (taste threshold).

[b]NYSDOH Maximum Contaminant Level.

[c]USEPA Secondary Maximum Contaminant Level.

[d]USEPA Treatment Technique.

[e]USEPA Proposed Maximum Contaminant Level.

Table 1–3. Concentrations of major ions in samples collected at springs and wells from the Iroquois National Wildlife Refuge, New York, 2009–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; C, Celsius; $CaCO_3$, calcium carbonate; (70300), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier [1]	Dissolved solids dried at 180 degrees C, filtered,mg/L (70300)	Hardness, mg/L as $CaCO_3$ (00900)	Calcium, filtered, mg/L (00915)	Magnesium, filtered, mg/L (00925)	Potassium, filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)
			Springs			
GS 290	272	43.5	11.9	3.32	5.6	1.18
GS 290	261	62.1	20.2	2.81	6.32	1.5
GS 291	898	93.8	21.5	9.73	9.49	5.1
GS 291	909	41.8	5.54	6.8	2.63	4.12
GS 292	735	248	77.2	13.6	11.9	9.14
GS 292	1,460	229	71.3	12.3	10.2	8.26
GS 293	1,400	238	73.4	13.3	20.6	10.1
GS 293	1,450	202	63.5	10.4	15.5	9.27
OL 43	1,280	826	224	64.8	5.97	51.9
OL 44	408	265	69.5	22.2	1.42	37.6
			WELLS			
GS 244	116	31	6.27	3.73	1.3	31
GS 286	15,100	5,360	1,420	440	54.5	3,580
GS 287	1,310	705	203	48.2	3.5	125
GS 288	737	379	92.3	36	5.52	74.6
OL 27	476	391	91.1	39.6	1.9	9.57
OL 37	1,820	1,170	345	74.8	5.35	75.3
OL 38	2,260	1,520	459	90.2	1.58	22.7
OL 39	2,050	1,330	384	89.6	2.2	89.5
OL 40	1,180	736	186	65.7	2.34	79.2
OL 41	316	256	43.6	35.7	1.23	11.2
OL 42	458	359	86.6	34.6	3.39	11.2
Drinking Water Standards (a, b,c,d, or e)	--	--	--	--	--	60[a]

[1]Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

[a]USEPA Drinking Water Health Advisory (taste threshold).

[b]NYSDOH Maximum Contaminant Level.

[c]USEPA Secondary Maximum Contaminant Level.

[d]USEPA Treatment Technique.

[e]USEPA Proposed Maximum Contaminant Level.

Table 1–4. Concentrations of major ions in samples collected from springs and wells at the Iroquois National Wildlife Refuge, New York, 2009–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; C, Celsius; $CaCO_3$, calcium carbonate; SiO2, silica dioxide; --, no information; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (29801), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier[1]	Alkalinity[2] filtered, mg/L as $CaCO_3$ (29801)	Bicarbonate[3] filtered, mg/L as $CaCO_3$ (29805)	Bromide, filtered, mg/L (71870)	Chloride, filtered, mg/L (00940)	Fluoride filtered, mg/L (00950)	Silica, filtered, mg/L as SiO_2 (00955)	Sulfate, filtered, mg/L (00945)
Springs							
GS 290	<8	<8	0.02	1.16	<.08	13.6	177
GS 290	--	--	<.02	0.69	E.08	13.1	279
GS 291	<8	<8	E.02	2.77	E.07	90.8	1,050
GS 291	--	--	E.01	1.48	0.16	63.4	887
GS 292	<8	<8	E.02	12.7	E.08	27.2	1,870
GS 292	--	--	E.02	12.0	0.14	20.9	1,730
GS 293	<8	<8	0.02	10.3	E.07	73.7	2,440
GS 293	--	--	0.02	10.5	0.16	44.0	1,660
OL 43	212	259	0.69	91.8	1.08	10.1	611
OL 44	233	284	0.02	69.2	0.26	13.4	28.4
Wells							
GS 244	70	85	--	20.5	0.64	2.55	3.98
GS 286	278	339	--	7,050	1.42	13.2	1,960
GS 287	301	367	--	197	0.32	16.7	405
GS 288	169	206	--	149	1.03	12.3	203
OL 27	239	292	--	16.7	0.78	17.2	124
OL 37	100	122	--	130	1.07	17.2	1,010
OL 38	176	215	--	34.6	1.52	16.7	1,370
OL 39	232	283	--	176	1.28	16.2	1,040
OL 40	239	292	--	195	1.10	17.6	403
OL 41	185	226	--	7.31	0.93	22.5	69.0
OL 42	180	220	--	20.6	1.41	10.4	160
Drinking Water Standards (a, b,c,d, or e)	--	--	--	250[b, c]	2.0 c–2.2[b]	--	250[b, c]

[1]Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

[2]Fixed-endpoint titration at pH 4.5.

[3]Calculated from alkalinity.

[a]USEPA Drinking Water Health Advisory (taste threshold).

[b]NYSDOH Maximum Contaminant Level.

[c]USEPA Secondary Maximum Contaminant Level.

[d]USEPA Treatment Technique.

[e]USEPA Proposed Maximum Contaminant Level.

Table 1–5. Concentrations of trace metals in samples collected at springs and wells at the Iroquois National Wildlife Refuge, New York, 2009–10.

[Site locations shown in figure 2. µg/L, micrograms per liter; <, less than; --, no information, E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (01106), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier [1]	Aluminum, filtered, µg/L (01106)	Barium, filtered, µg/L (01005)	Beryllium, filtered, µg/L (01010)	Cadmium, filtered, µg/L (01025)	Chromium, filtered, µg/L (01030)	Cobalt, filtered, µg/L (01035)	Copper, filtered, µg/L (01040)	Iron, filtered, µg/L (01046)	Lead, filtered, µg/L (01049)	Manganese, filtered, µg/L (01056)
Springs										
GS 290	1,300	18	0.08	0.22	1.2	1.9	1.2	10,400	27.2	738
GS 290	2,340	34	0.11	0.59	1.9	1.9	2.4	7,790	8.45	657
GS 291	25,300	26	0.86	0.58	12.9	6.6	E1.2	43,500	22.0	618
GS 291	18,800	22	0.64	0.43	8.6	4.8	<10.0	11,500	16.4	426
GS 292	3,780	35	0.18	0.42	3.1	2.0	<4.0	3,440	25.3	277
GS 292	3,470	28	0.11	0.3	2.1	2.1	<4.0	3,590	17.0	292
GS 293	17,900	21	0.65	0.36	13.3	2.5	<5.0	11,900	19.5	348
GS 293	11,000	15	0.39	E.14	6.2	1.5	<10.0	8,000	12.3	238
OL 43	10.2	13	0.01	<.02	0.16	1.2	<1.0	50	E.08	18.1
OL 44	10.1	69	<.01	0.14	0.61	0.17	<1.0	10	0.04	0.8
Wells										
GS 244	<4.0	9	<.02	E.01	0.37	<.02	<1.0	26	E.05	2.0
GS 286	<40.0	38	<.20	<.20	E1.1	1.4	<10.0	109	<.60	88.1
GS 287	<12.0	58	<.06	<.06	<.36	0.89	<3.0	447	0.64	34.0
GS 288	<12.0	63	<.06	<.06	<.36	0.15	<3.0	3,430	<.18	164
OL 27	<4.0	76	<.02	<.02	<.12	0.22	<1.0	512	<.06	18.0
OL 37	E2.2	35	<.02	0.02	<.12	0.36	<1.0	10	<.06	7.5
OL 38	<8.0	8	<.04	<.04	<.24	0.44	<2.0	4,640	<.12	59.0
OL 39	<8.0	34	<.04	<.04	<.24	0.52	<2.0	42	0.73	26.0
OL 40	<8.0	39	<.04	<.04	<.24	1.4	<2.0	222	0.36	37.1
OL 41	<4.0	59	<.02	<.02	<.12	0.05	<1.0	271	<.06	6.0
OL 42	4.2	21	<.02	0.03	E.10	0.08	<1.0	48	<.06	4.2
Drinking Water Standards (a, b,c,d, or e)	50[c]	2,000[a,b]	4[a,b]	5[a,b]	100[a,b]	--	1,000[c]	300[b, c]	15[d]	50[c]–300[d]

[1]Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

[a]USEPA Drinking Water Health Advisory (taste threshold).

[b]NYSDOH Maximum Contaminant Level.

[c]USEPA Secondary Maximum Contaminant Level.

[d]USEPA Treatment Technique.

[e]USEPA Proposed Maximum Contaminant Level.

Table 1–5. Concentrations of trace metals in samples collected at springs and wells at the Iroquois National Wildlife Refuge, New York, 2009–10.—Continued

[Site locations shown in figure 2. µg/L, micrograms per liter; <, less than; --, no infomation, E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (01060), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Site identifier [1]	Molybdenum, filtered, µg/L (01060)	Nickel, filtered, µg/L (01065)	Silver, filtered, µg/L (01075)	Zinc, filtered, µg/L (01090)	Antimony, filtered, µg/L (01095)	Arsenic, filtered, µg/L (01000)	Selenium, filtered, µg/L (01145)	Uranium (natural), filtered, µg/L (22703)
				SPRINGS				
GS 290	0.1	2.3	<.01	80.8	0.12	1.4	0.19	0.02
GS 290	0.1	4.2	E.01	90.0	0.10	2.1	0.23	0.05
GS 291	0.1	16.2	<.02	188	<.11	5.4	0.39	0.07
GS 291	<.3	12.4	<.10	144	<.54	4.0	E.35	E.07
GS 292	E.1	4.9	<.04	114	E.15	1.4	0.35	0.09
GS 292	E.1	3.4	<.04	77.2	E.18	0.75	0.22	0.08
GS 293	0.2	7.8	<.05	112	<.27	2.0	0.43	0.16
GS 293	<.3	4.6	<.10	67.1	<.54	1.3	0.43	0.16
OL 43	0.3	4.0	E.01	2.9	0.07	1.3	0.09	0.61
OL 44	0.6	1.3	<.01	100	E.05	0.40	0.26	0.99
				WELLS				
GS 244	2.6	E.12	E.01	<2.0	E.02	0.25	<.06	<.01
GS 286	1.2	7.4	E.06	<20.0	0.43	2.7	1.7	0.46
GS 287	1.7	2.4	0.05	10.6	E.08	0.64	<.18	2.38
GS 288	2.8	0.87	0.04	E3.6	0.52	0.26	<.18	0.13
OL 27	1.4	0.63	<.01	2.2	E.02	2.3	<.06	1.09
OL 37	8.7	1.8	E.01	<2.0	0.08	1.1	<.60	1.15
OL 38	0.1	2.3	<.02	<4.0	<.08	0.15	<.60	0.03
OL 39	0.7	3.4	<.02	E3.5	<.08	0.22	<.60	0.51
OL 40	1.2	3.4	<.02	199	<.08	0.43	<.12	0.61
OL 41	1.6	0.24	<.01	E1.9	E.03	2.8	<.06	0.05
OL 42	1.1	0.43	<.01	<2.0	0.04	0.10	<.06	0.06
Drinking Water Standards (a, b,c,d, or e)	--	--	100[a, b]	5,000[b, c]	6[a, b]	10[a]	50[a, b]	30[a]

[1] Prefix denotes county: GS, Genesee; OL, Orleans; number is local well-identification number assigned by U.S. Geological Survey.

[a]USEPA Drinking Water Health Advisory (taste threshold).

[b]NYSDOH Maximum Contaminant Level.

[c]USEPA Secondary Maximum Contaminant Level.

[d]USEPA Treatment Technique.

[e]USEPA Proposed Maximum Contaminant Level.

Table 1–6. Site information and physical properties of stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. --, no data; mi², drainage area in square miles; (00300), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Sample date	Dissolved oxygen, unfiltered, milligrams per liter (00300)	pH, unfiltered, standard units (00400)	Salinity, unfiltered, parts per thousand (00480)	Specific conductance, unfiltered, microsiemens per centimeter at 25 degrees Celsius (00095)	Temperature, water, degrees Celsius (00010)
		04219979 Brinningstool Creek at Wheatville (5.43 mi²)			
3/12/2009	8.8	8.4	--	570	3.8
		0421999720 Oak Orchard Cr trib (Shelby Rd) nr East Shelby (1.50 mi²)			
3/12/2009	11.9	7.8	--	224	0.2
		0421999750 Oak Orchard Cr trib at Roberts Rd nr Alabama (1.92 mi²)			
3/12/2009	12.5	8.3	--	893	2.1
		04219999 Oak Orchard Cr trib (Sour Springs Rd) at Shelby (0.47 mi²)			
3/12/2009	4.7	7.5	--	342	0.5
		04219997 Oak Orchard Creek near Wheatville (108 mi²)			
11/6/2008	5.3	7.5	--	1,550	8.9
3/12/2009	9.1	8.3	--	650	2.1
9/4/2009	1.3	7.9	1.0	1,900	17.0
5/5/2010	--	--	0.7	1,390	17.0
7/19/2010	6.5	7.4	0.9	1,730	23.3
9/17/2010	7.2	7.4	1.0	1,970	13.1
		04219998 Oak Orchard Creek at SR 63 near West Shelby (126 mi²)			
11/6/2008	5.0	7.5	--	1,370	8.3
3/12/2009	9.8	8.1	--	382	2.1
9/4/2009	1.0	7.5	0.7	1,470	19.4
5/5/2010	--	--	0.7	1,320	18.2
7/19/2010	7.5	5.6	0.9	1,720	24.6
9/17/2010	7.2	7.5	1.0	1,970	14.2
		04220045 Oak Orchard Creek near Shelby (146 mi²)			
11/6/2008	6.0	7.5	--	1,270	9.1
3/12/2009	10.8	7.9	--	517	2.2
9/4/2009	1.3	7.5	0.7	1,330	19.0
5/5/2010	--	--	0.6	1,270	20.6
7/19/2010	4.9	7.4	0.8	1,650	24.3
9/17/2010	7.2	7.4	1.0	1,950	14.4

Table 1–7. Concentrations of nutrients in stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; N, nitrogen; P, phosphorus; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (00623), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Sample date	Ammonia plus organic N, filtered, mg/L as N (00623)	Ammonia plus organic N, unfiltered, mg/L as N (00625)	Ammonia, filtered, mg/L as N (00608)	Nitrate plus nitrite, filtered, mg/L as N (00631)	Nitrite, filtered, mg/L as N (00613)	Orthophosphate, filtered, mg/L as P (00671)	Phosphorus, filtered, mg/L as P (00666)	Phosphorus, unfiltered, mg/L as P (00665)
04219979 Brinningstool Creek at Wheatville (5.43 mi^2)								
3/12/2009	0.62	0.93	0.079	2.63	0.013	0.093	0.107	0.213
0421999720 Oak Orchard Creek tributary (Shelby Road) near East Shelby (1.50 mi^2)								
3/12/2009	0.5	0.82	<.020	0.41	0.003	0.016	0.033	0.146
0421999750 Oak Orchard Creek tributary at Roberts Road near Alabama (1.92 mi mi^2)								
3/12/2009	0.99	1.2	0.337	1.95	0.015	0.074	0.091	0.147
04219999 Oak Orchard Creek tributary (Sour Springs Road) at Shelby (0.47 mi^2)								
3/12/2009	0.57	0.79	0.044	0.38	0.003	0.034	0.056	0.161
04219997 Oak Orchard Creek near Wheatville (108 mi^2)								
11/6/2008	1.5	1.9	0.052	3.96	0.030	0.221	0.249	0.400
3/12/2009	0.97	1.2	0.056	2.19	0.014	0.199	0.236	0.294
9/4/2009	0.84	1.5	0.037	2.49	0.010	0.194	0.229	0.585
5/5/2010	0.92	1.7	0.081	1.42	0.036	0.128	0.165	0.492
7/19/2010	0.97	2.0	0.064	3.62	0.025	0.523	0.562	0.999
9/17/2010	1.2	2.7	0.111	2.49	0.016	0.193	0.229	0.810
04219998 Oak Orchard Creek at SR63 near West Shelby (126 mi^2)								
11/6/2008	1.5	1.6	0.055	2.92	0.027	0.198	0.230	0.289
3/12/2009	0.8	0.95	E.019	1.79	0.013	0.152	0.167	0.226
9/4/2009	1.1	1.6	0.049	1.17	0.010	0.214	0.256	0.572
5/5/2010	0.85	1.5	0.075	1.03	0.020	0.111	0.142	0.309
7/19/2010	1.1	2.1	0.122	2.27	0.038	0.269	0.314	0.721
9/17/2010	0.86	1.2	0.049	2.09	0.011	0.185	0.194	0.365
04220045 Oak Orchard Creek near Shelby (146 mi^2)								
11/6/2008	1.4	1.5	0.037	2.42	0.026	0.176	0.197	0.246
3/12/2009	0.75	0.97	0.023	1.48	0.013	0.105	0.126	0.189
9/4/2009	1.1	1.3	0.053	0.77	0.010	0.206	0.255	0.423
5/5/2010	1.1	1.4	0.076	0.95	0.018	0.087	0.129	0.306
7/19/2010	1.3	1.9	0.141	1.79	0.028	0.247	0.284	0.459
9/17/2010	0.84	1.2	0.033	1.90	0.008	0.147	0.167	0.348

Table 1–8. Concentrations of major ions in stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; <, less than; (70300), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Sample date	Dissolved solids dried at 180 degrees Celsius, filtered, mg/L (70300)	Hardness, filtered, mg/L as $CaCO_3$ (00900)	Calcium, filtered, mg/L (00915)	Magnesium, filtered, mg/L (00925)	Potassium, filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)
04219979 Brinningstool Creek at Wheatville (5.43 mi^2)						
3/12/2009	322	232	68.8	14.6	5.08	19.2
0421999720 Oak Orchard Creek tributary (Shelby Road) near East Shelby (1.50 mi^2)						
3/12/2009	141	87.7	23.6	6.97	2.76	8.63
0421999750 Oak Orchard Creek tributary at Roberts Road near Alabama (1.92 mi^2)						
3/12/2009	601	423	134	21.2	7.34	15.4
04219999 Oak Orchard Creek tributary (Sour Springs Road) at Shelby (0.47 mi^2)						
3/12/2009	196	129	33.1	11.3	4.86	9.86
04219997 Oak Orchard Creek near Wheatville (108 mi^2)						
11/6/2008	1,240	818	266	37.6	8.07	29.2
3/12/2009	316	212	65.0	11.9	4.96	13.7
9/4/2009	1,620	1,090	369	40.8	8.46	40.6
5/5/2010	1,040	718	231	34.2	4.31	34.0
7/19/2010	1,390	895	295	38.3	12.8	45.4
9/17/2010	1,660	1,110	378	40.0	11.0	49.7
04219998 Oak Orchard Creek at SR63 near West Shelby (126 mi^2)						
11/6/2008	1,040	695	224	32.8	8.06	26.1
3/12/2009	286	193	59.7	10.7	4.95	12.9
9/4/2009	1,100	749	244	33.8	7.18	36.8
5/5/2010	954	653	209	31.9	3.77	29.5
7/19/2010	1,380	916	304	38.5	12.9	46.3
9/17/2010	1,650	1,090	366	41.6	11.5	50.5
04220045 Oak Orchard Creek near Shelby (146 mi^2)						
11/6/2008	972	610	196	29.3	7.32	24.7
3/12/2009	317	222	69.1	12.1	4.58	13.7
9/4/2009	985	673	218	30.9	6.17	33.2
5/5/2010	918	644	206	31.3	4.00	28.5
7/19/2010	1,320	856	283	36.4	11.1	41.8
9/17/2010	1,640	1,080	367	40.3	10.8	49.3

Table 1–9. Concentrations of major ions in stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; SiO_2, silica dioxide; --, no information; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (29801), U.S. Geological Survey National Water Information System (NWIS) parameter code; alkalinity determined from fixed-endpoint titration to pH 4.5; bicarbonate concentration calculated from alkalinity concentration]

Sample date	Alkalinity filtered, mg/L as $CaCO_3$ (29801)	Bicarbonate filtered, mg/L as $CaCO_3$ (29805)	Bromide, filtered, mg/L (71870)	Chloride, filtered, mg/L (00940)	Fluoride filtered, mg/L (00950)	Silica, filtered, mg/L as SiO_2 (00955)	Sulfate, filtered, mg/L (00945)
04219979 Brinningstool Creek at Wheatville (5.43 mi^2)							
3/12/2009	145	177	E.01	35.1	0.15	5.16	73.4
0421999720 Oak Orchard Creek tributary (Shelby Road) near East Shelby (1.50 mi^2)							
3/12/2009	66	81	<.02	18.3	0.12	6.15	13.7
0421999750 Oak Orchard Creek tributary at Roberts Road near Alabama (1.92 mi^2)							
3/12/2009	180	220	0.02	31.9	0.16	5.80	241
04219999 Oak Orchard Creek tributary (Sour Springs Road) at Shelby (0.47 mi^2)							
3/12/2009	96	117	E.01	22.4	0.21	6.22	25.7
04219997 Oak Orchard Creek near Wheatville (108 mi^2)							
11/6/2008	240	293	0.08	63.6	0.41	9.70	531
3/12/2009	112	137	0.03	26.0	0.19	3.75	86.5
9/4/2009	293	357	0.11	80.6	0.55	8.63	761
5/5/2010	272	332	0.07	62.8	0.40	5.12	420
7/19/2010	300	366	0.49	79.5	0.48	7.80	582
9/17/2010	285	348	0.65	87.1	0.50	8.29	791
04219998 Oak Orchard Creek at SR63 near West Shelby (126 mi^2)							
11/6/2008	211	257	0.07	58.6	0.32	11.1	441
3/12/2009	101	123	E.02	24.5	0.17	2.86	79.0
9/4/2009	291	355	0.12	69.0	0.41	9.99	446
5/5/2010	260	317	0.06	56.6	0.39	4.82	373
7/19/2010	295	360	0.50	79.3	0.48	8.47	589
9/17/2010	284	346	0.72	85.2	0.51	7.33	809
04220045 Oak Orchard Creek near Shelby (146 mi^2)							
11/6/2008	204	249	0.07	55.9	0.33	10.1	393
3/12/2009	104	127	0.02	24.5	0.17	2.35	101
9/4/2009	280	342	0.12	63.2	0.39	10.5	375
5/5/2010	261	318	0.07	56.0	0.38	4.99	348
7/19/2010	294	359	0.40	76.4	0.49	8.65	556
9/17/2010	279	340	0.70	83.5	0.49	6.68	794

Table 1–10. Concentrations of trace metals in stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. µg/L, micrograms per liter; --, no information; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (01106), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Sample date	Aluminum, filtered, µg/L (01106)	Barium, filtered, µg/L (01005)	Beryllium, filtered, µg/L (01010)	Cadmium, filtered, µg/L (01025)	Chromium, filtered, µg/L (01030)	Cobalt, filtered, µg/L (01035)	Copper, filtered, µg/L (01040)	Iron, filtered, µg/L (01046)	Lead, filtered, µg/L (01049)	Manganese, filtered, µg/L (01056)
04219979 Brinningstool Creek at Wheatville (5.43 mi²)										
3/12/2009	--	--	--	--	--	--	--	25	--	3.9
0421999720 Oak Orchard Creek tributary (Shelby Road) near East Shelby (1.50 mi²)										
3/12/2009	--	--	--	--	--	--	--	246	--	5.6
0421999750 Oak Orchard Creek tributary at Roberts Road near Alabama (1.92 mi²)										
3/12/2009	--	--	--	--	--	--	--	33	--	13.2
04219999 Oak Orchard Creek tributary (Sour Springs Road) at Shelby (0.47 mi²)										
3/12/2009	--	--	--	--	--	--	--	56	--	10.2
04219997 Oak Orchard Creek near Wheatville (108 mi²)										
11/6/2008	--	--	--	--	--	--	--	129	--	77.2
3/12/2009	--	--	--	--	--	--	--	86	--	10.1
9/4/2009	--	--	--	--	--	--	--	43	--	92.1
5/5/2010	5.2	42	<.01	0.34	E.09	0.86	2.8	59	0.09	183
7/19/2010	7.1	42	<.01	0.03	E.08	0.79	2.8	29	0.17	142
9/17/2010	5.9	40	E.01	0.60	E.07	0.32	2.1	34	0.06	139
04219998 Oak Orchard Creek at SR63 near West Shelby (126 mi²)										
11/6/2008	--	--	--	--	--	--	--	159	--	86.6
3/12/2009	--	--	--	--	--	--	--	69	--	3.6
9/4/2009	--	--	--	--	--	--	--	83	--	154
5/5/2010	10.1	37	<.01	0.19	E.10	0.71	2.2	72	0.09	180
7/19/2010	7.5	43	<.01	0.17	0.44	0.69	2.3	36	0.14	167
9/17/2010	5.6	44	E.01	0.20	<.12	0.91	1.4	27	0.05	155

Table 1–10. Concentrations of trace metals in stream samples collected at the Iroquois National Wildlife Refuge, New York, 2008–10.

[Site locations shown in figure 2. µg/L, micrograms per liter; --, no information; <, less than; E, estimated value—constituent was detected in the sample but with low or inconsistent recovery; (01106), U.S. Geological Survey National Water Information System (NWIS) parameter code]

Sample date	Aluminum, filtered, µg/L (01106)	Barium, filtered, µg/L (01005)	Beryllium, filtered, µg/L (01010)	Cadmium, filtered, µg/L (01025)	Chromium, filtered, µg/L (01030)	Cobalt, filtered, µg/L (01035)	Copper, filtered, µg/L (01040)	Iron, filtered, µg/L (01046)	Lead, filtered, µg/L (01049)	Manganese, filtered, µg/L (01056)
04220045 Oak Orchard Creek near Shelby (146 mi²)										
11/6/2008	--	--	--	--	--	--	--	118	--	50.0
3/12/2009	--	--	--	--	--	--	--	51	--	6.9
9/4/2009	--	--	--	--	--	--	--	99	--	180
5/5/2010	7.8	37	E.01	0.23	0.12	0.81	3.3	64	0.10	145
7/19/2010	7.2	42	E.01	0.39	E.09	0.59	2.0	36	0.12	184
9/17/2010	E5.4	47	<.04	0.13	<.36	0.88	<3.0	21	E.05	152

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Appendix 2. Hydrographs of 17 Groundwater-Monitoring Wells in and around the Iroquois National Wildlife Refuge, 3 Regional Groundwater Wells, and 2 Stream Sites of Oak Orchard Creek at Sour Springs Road and Harrison Road, November 2008 to November 2010.

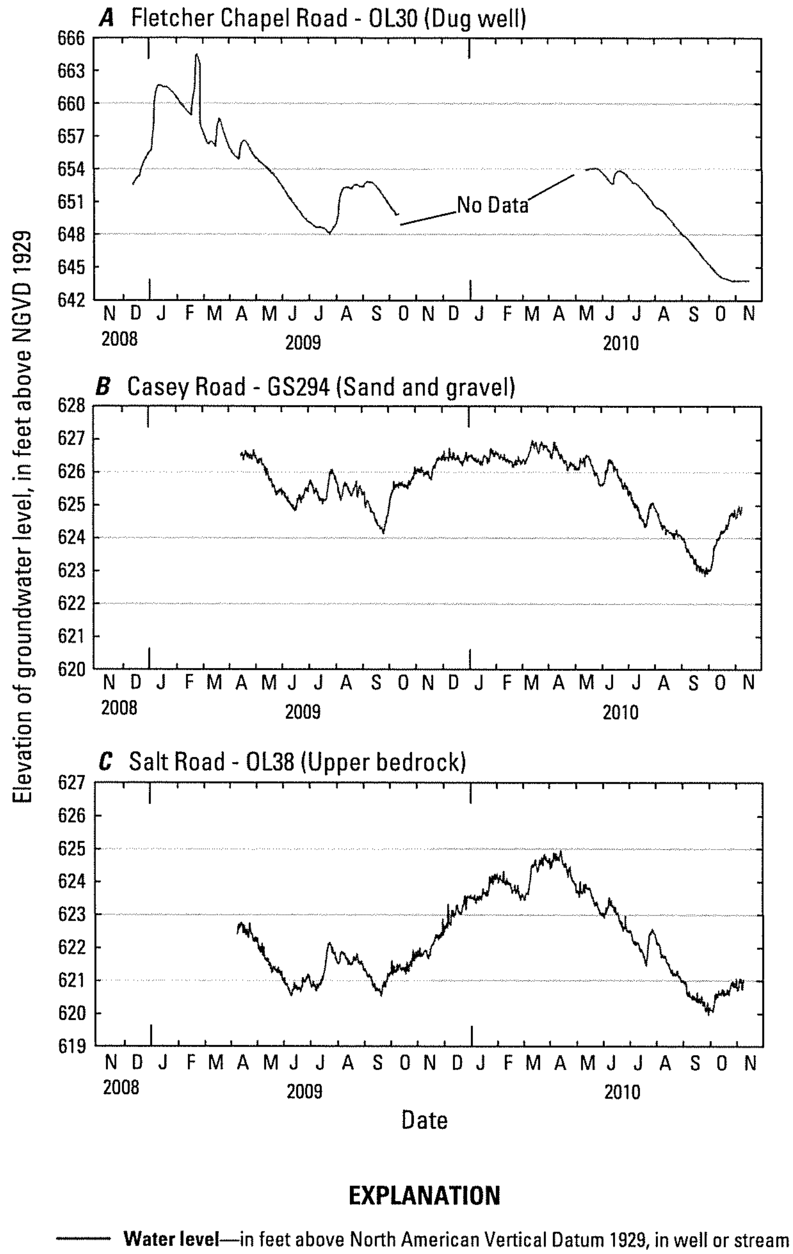


Figure 2–1. Hydrographs of water levels in wells *A,* Fletcher Chapel Road, OL30; *B,* Casey Road , GS294; and *C,* Salt Road, OL38 in or near Iroquois National Wildlife Refuge, Orleans and Genesee Counties, New York, 2008–10.

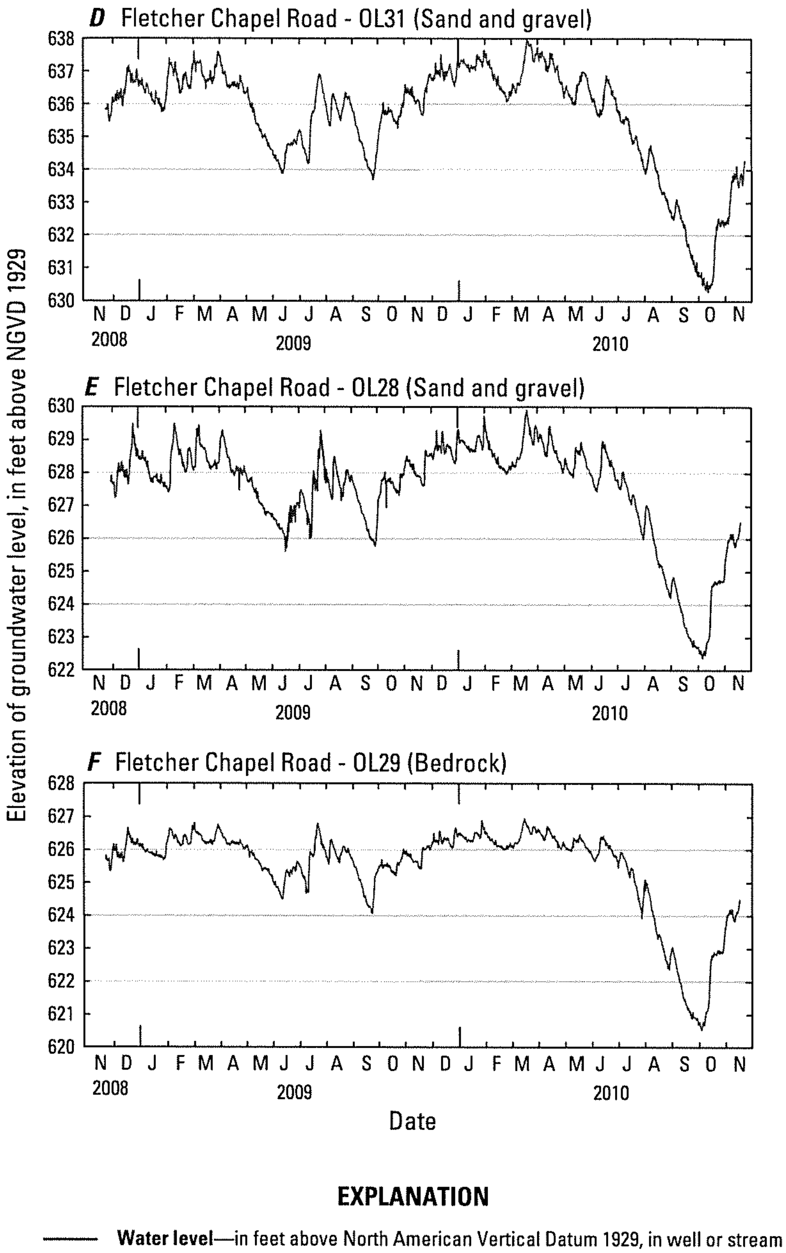
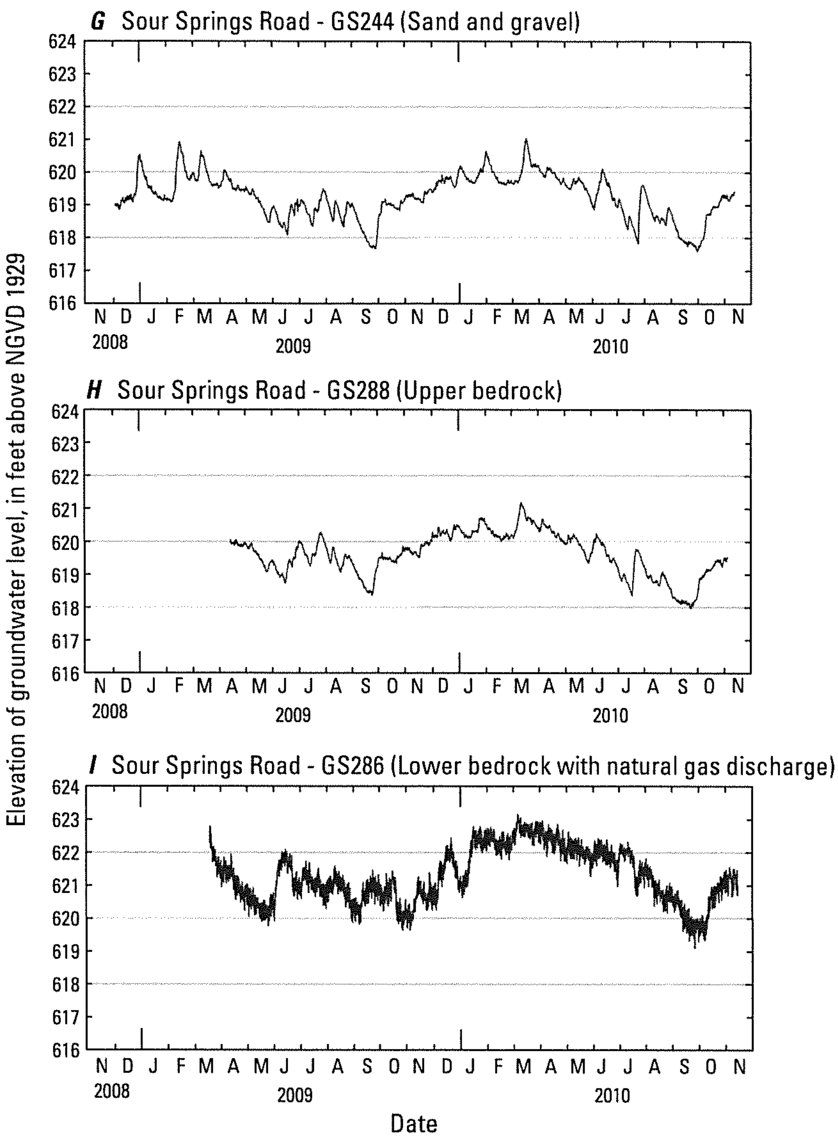


Figure 2–2. Hydrographs of water levels in wells *D*, Fletcher Chapel Road, OL31; *E*, Fletcher Chapel Road, OL28; and *F*, Fletcher Chapel Road, OL29 near Iroquois National Wildlife Refuge, Orleans County, New York, 2008–10.



EXPLANATION

Water level—in feet above North American Vertical Datum 1929, in well or stream

Figure 2–3. Hydrographs of water levels in wells *G,* Sour Springs Road, GS244; *H,* Sour Springs Road, GS288; and *I,* Sour Springs Road-GS286 in Iroquois National Wildlife Refuge, Genesee County, New York, 2008–10.

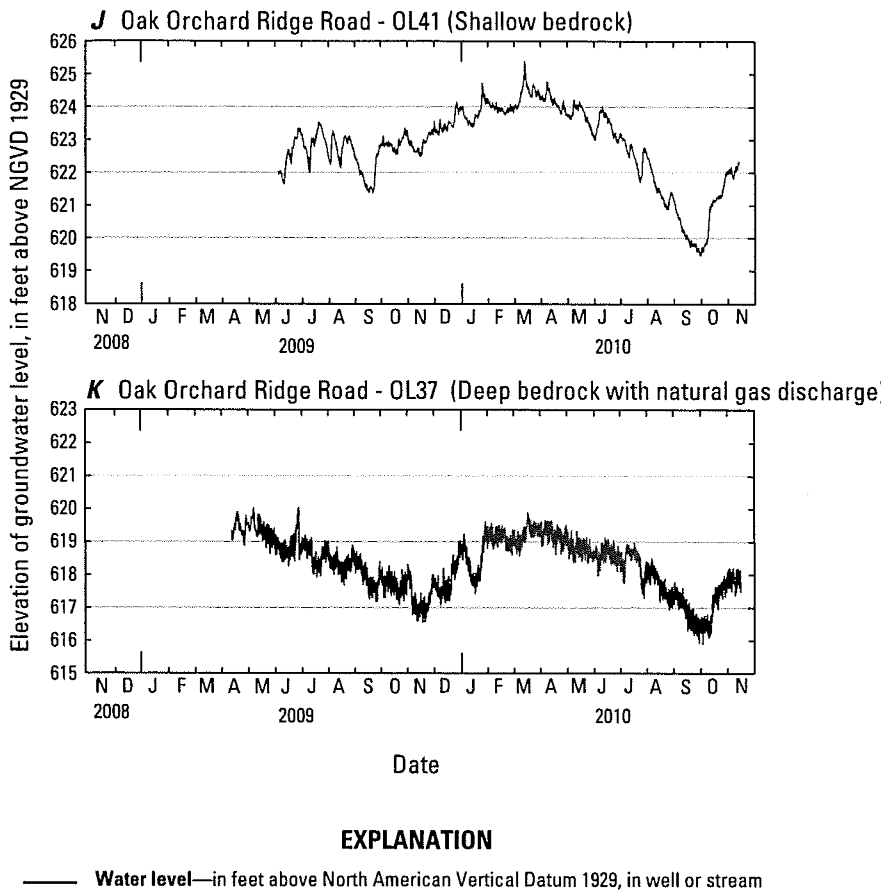


Figure 2–4. Hydrographs of water levels in wells *J*, Oak Orchard Ridge Road, OL41; and *K*, Oak Orchard Ridge Road, OL37 in Iroquois National Wildlife Refuge, Orleans County, New York, 2008–10.

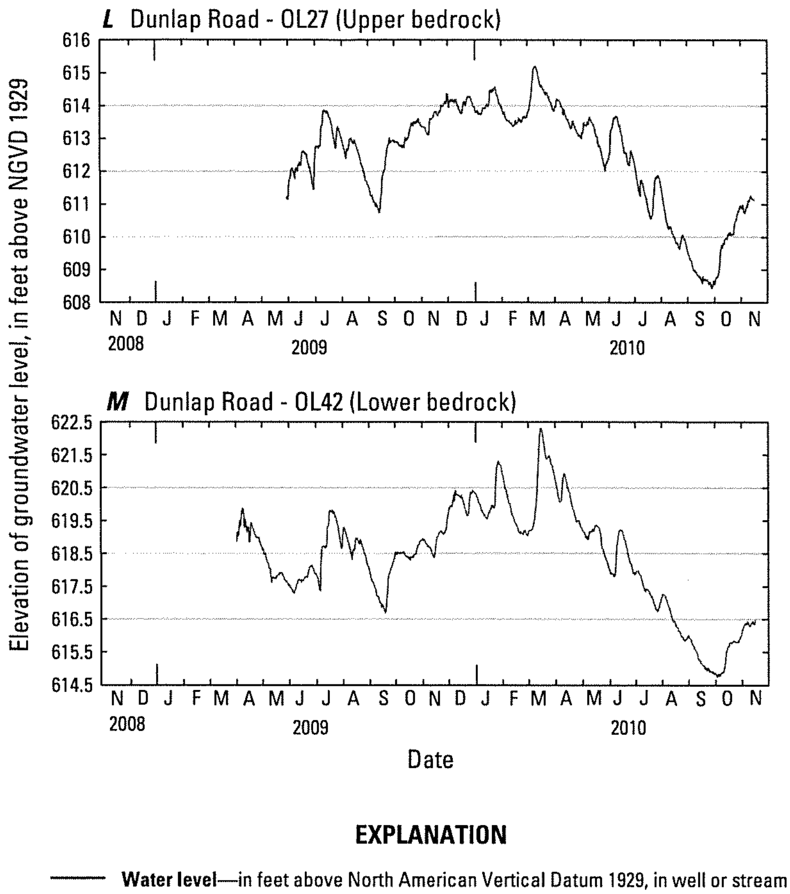
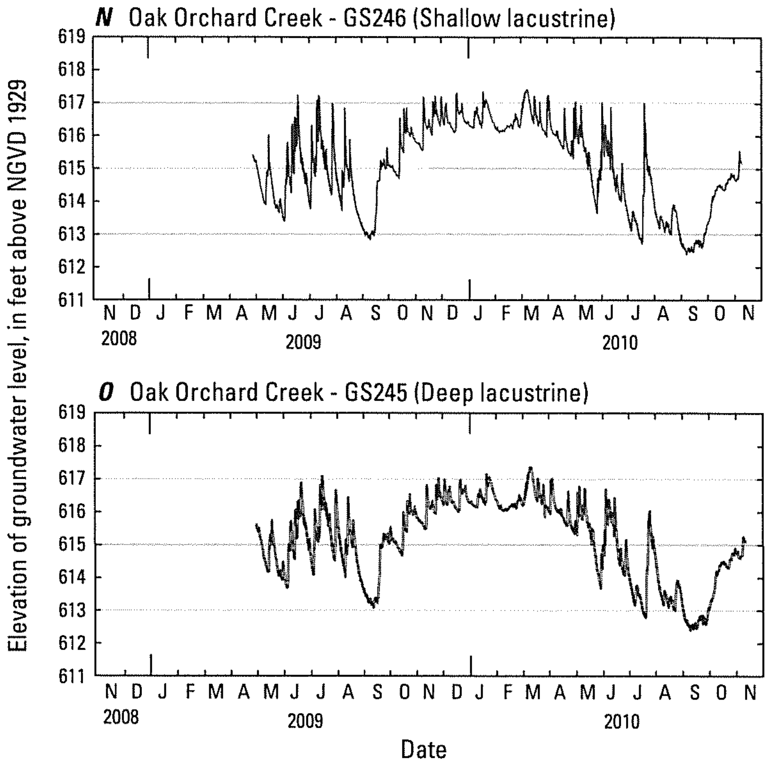


Figure 2–5. Hydrographs of water levels in wells *L*, Dunlap Road, OL27; and *M*, Dunlap Road, OL42 in Iroquois National Wildlife Refuge, Orleans County, New York, 2008–10.



EXPLANATION

—— **Water level**—in feet above North American Vertical Datum 1929, in well or stream

Figure 2–6. Hydrographs of water levels in wells *N,* Oak Orchard Creek, GS246; and *O,* Oak Orchard Creek, GS245 in Iroquois National Wildlife Refuge, Genesee County, New York, 2008–10.

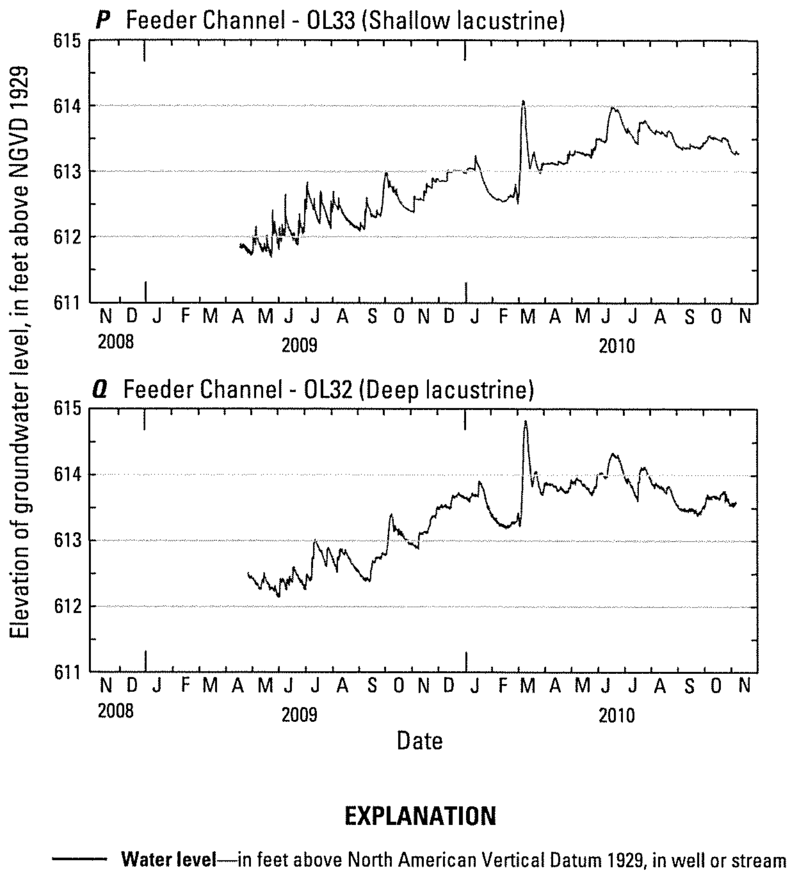


Figure 2–7. Hydrographs of water levels in wells *P*, Feeder Channel, OL33; and *Q*, Feeder Channel, OL32 in Iroquois National Wildlife Refuge, Orleans County, New York, 2008–10.

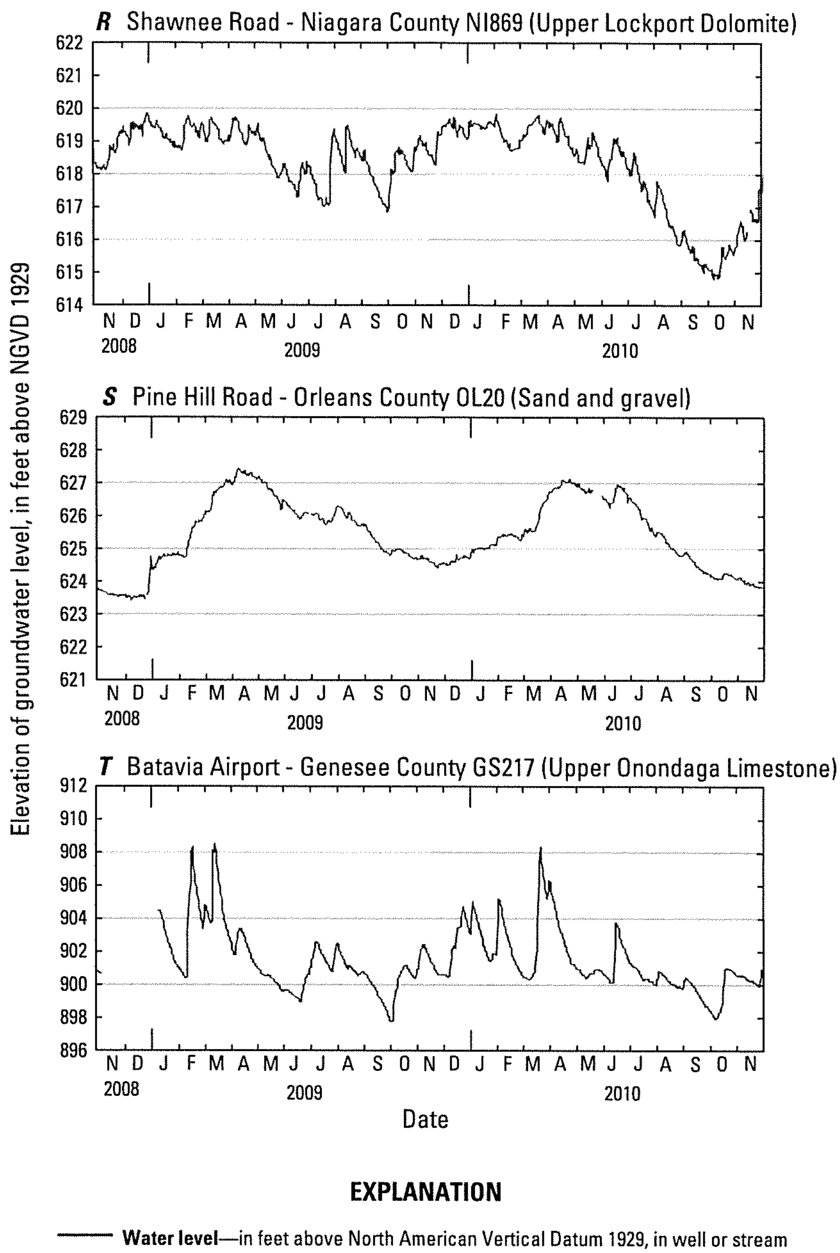


Figure 2–8. Hydrographs of water levels in regional wells *R,* Shawnee Road, NI869; *S,* Pine Hills Road, OL20; and *T,* Batavia Airport, GS217 in Niagara, Orleans, and Genesee Counties, New York, 2008–10.

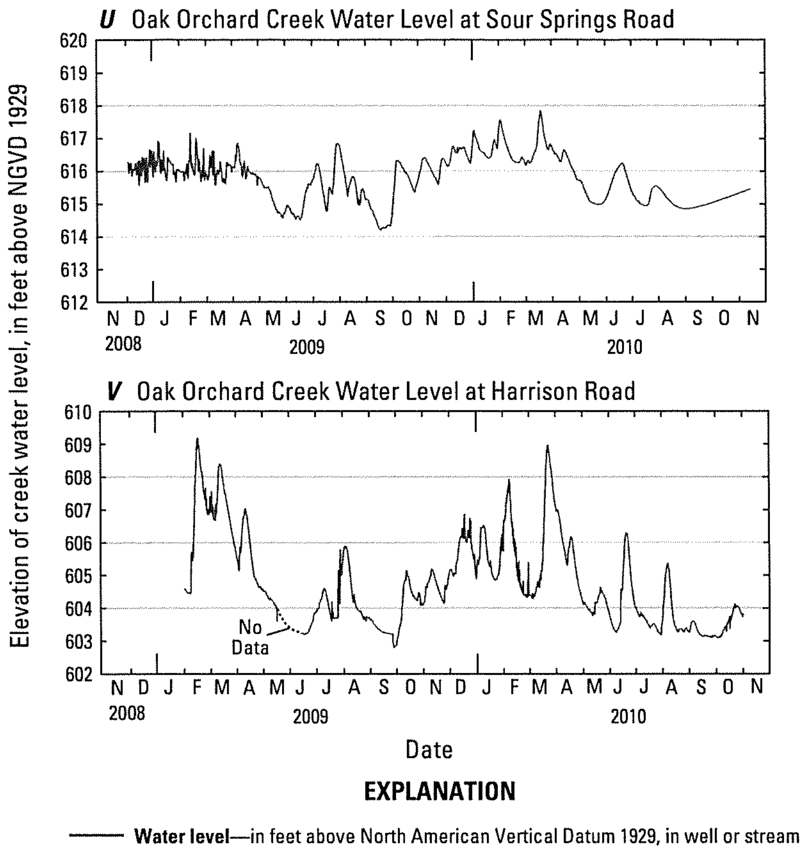


Figure 2–9. Stream hydrographs in *U,* Oak Orchard Creek at Sour Springs Road; and *V,* Oak Orchard Creek at Harrison Road in or near Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2008–10.

Appendix 3. Borehole Geophysical Logs for Four Test Holes —OL27–Dunlap Road, OL37–Oak Orchard Ridge Road, OL38–Salt Road, and GS286–Sour Springs Road—Drilled in the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York.

Explanation

OL27	USGS well identifier
Depth	Depth, in feet below land surface at specified vertical scale
Form	Stratigraphic formation
Litho	Stratigraphic member
Gamma	Natural gamma radiation, in counts per second (cps)
Cond	Formation conductivity millisiemens per meter
Caliper	Mechanical three-arm caliper, borehole diameter in inches
OTV	Optical-televiewer image, 360-degree optical image of borehole wall oriented to True Geographic North
Acou ATV	Acoustic-televiewer image; 360-degree acoustic image of borehole wall oriented to True Geographic North
EMFM	Flow measured by electromagnetic flowmeter (-amb, ambient; -pmp, pumped), in gallons per minute[1]
Fl Cond	Fluid conductivity (-amb, ambient; -pmp, pumped), in microsiemens per centimeter at 25 degrees Celsius[1]
Temp	Temperature (-amb, ambient; -pmp, pumped), in degrees Celsius[1]
HPFM	Flow measured by heat-pulse flowmeter (-amb, ambient; -pmp, pumped), in gallons per minute[1]
Trans	Transmissivity of flow zone based on USGS flow-log analysis, in feet squared per day
Completion	Location of steel casing and shale packer in test well
Head Config	Relative head (water-level) relationship in the test well

[1]Blue square indicates ambient stationary measurement; blue line indicates ambient trolling measurement; red open square indicates pumped stationary measurement; red line indicates pumped trolling measurement; downward flow is negative; upward flow is positive.

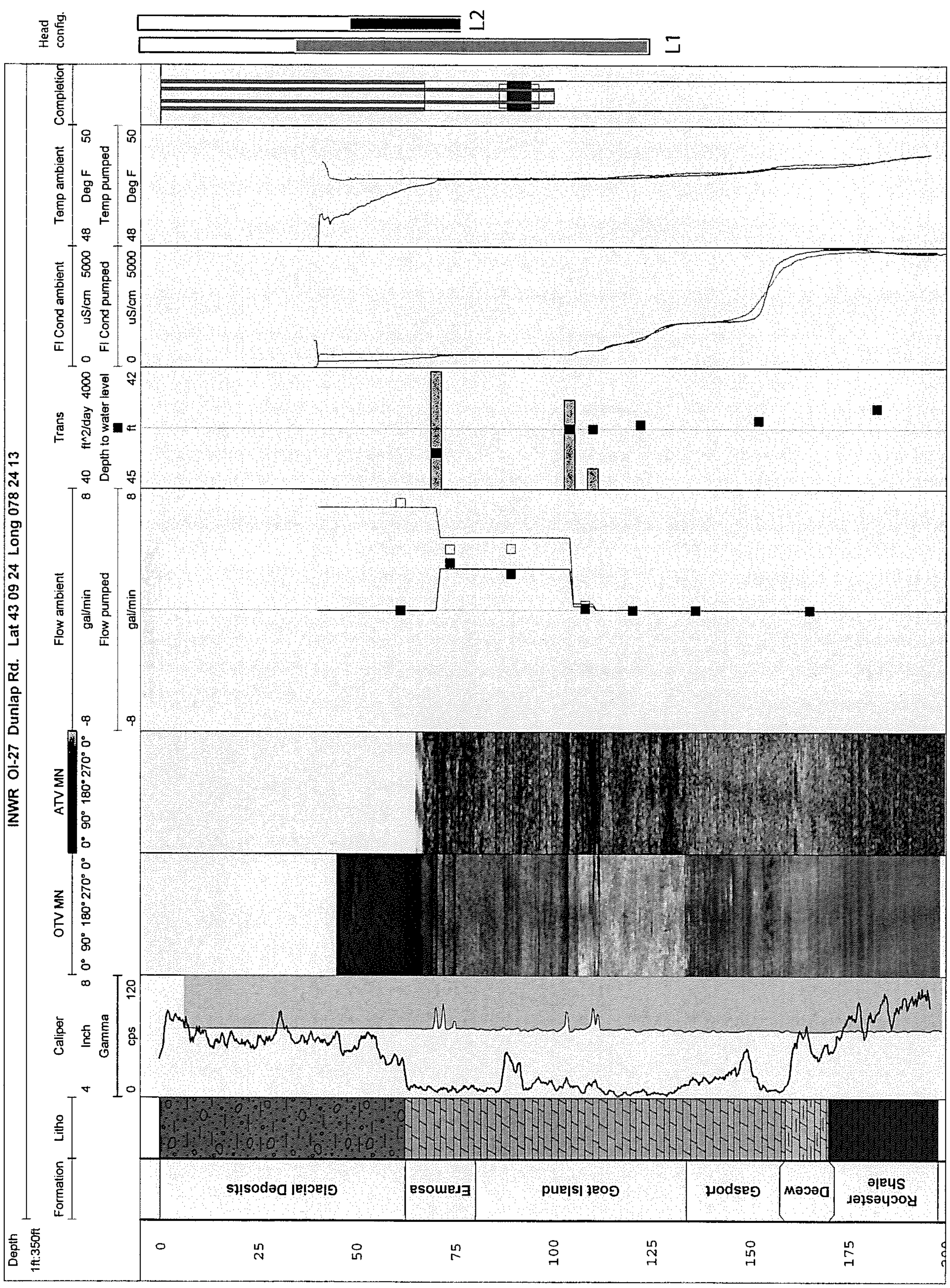


Figure 3–1. Borehole geophysical log for test hole OL27 Dunlap Road, Orleans County, New York.

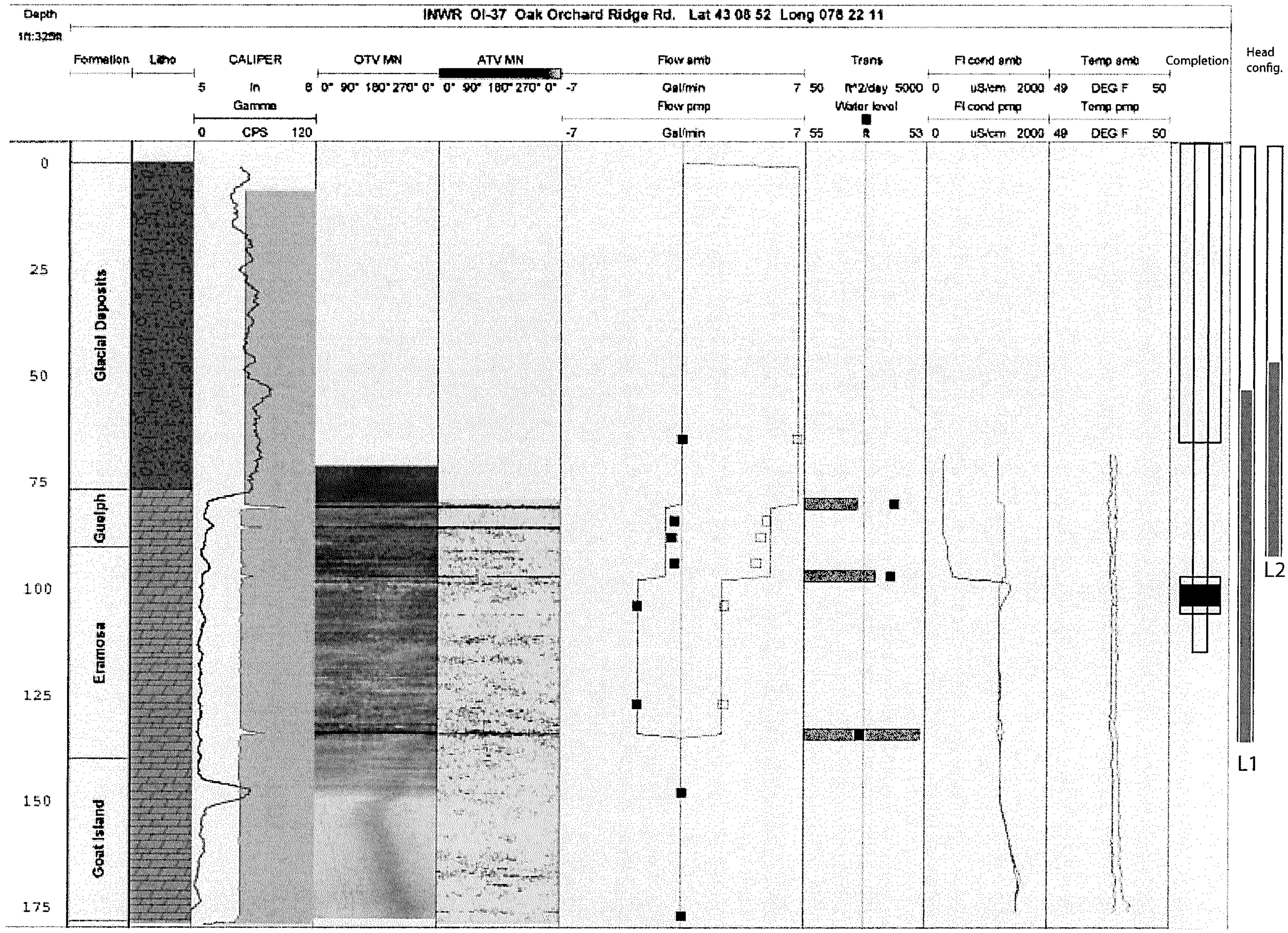


Figure 3–2. Borehole geophysical log for test hole OL37 Oak Orchard Ridge Road, Orleans County, New York.

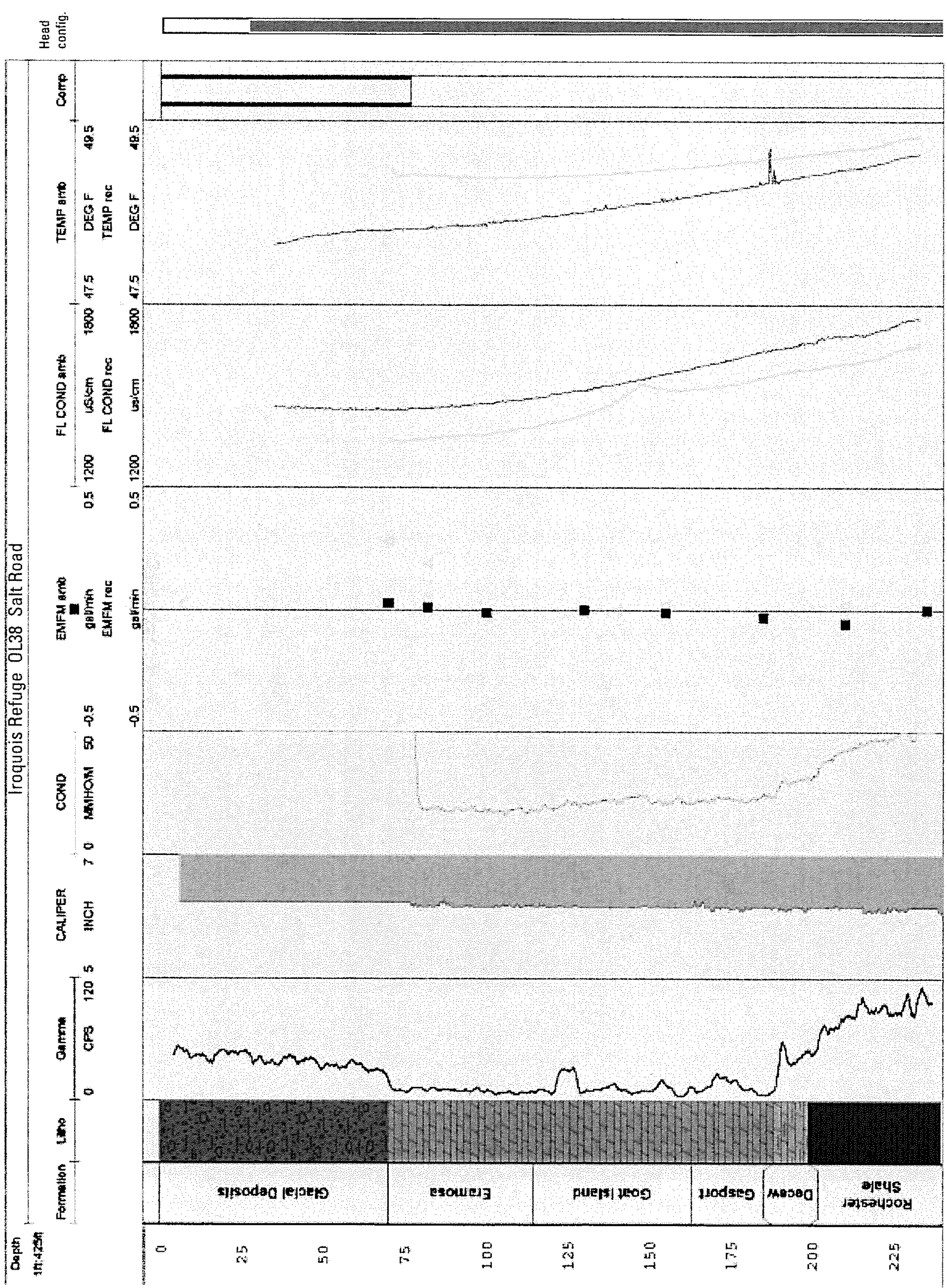


Figure 3–3. Borehole geophysical log for test hole OL38 Salt Road, Orleans County, New York.

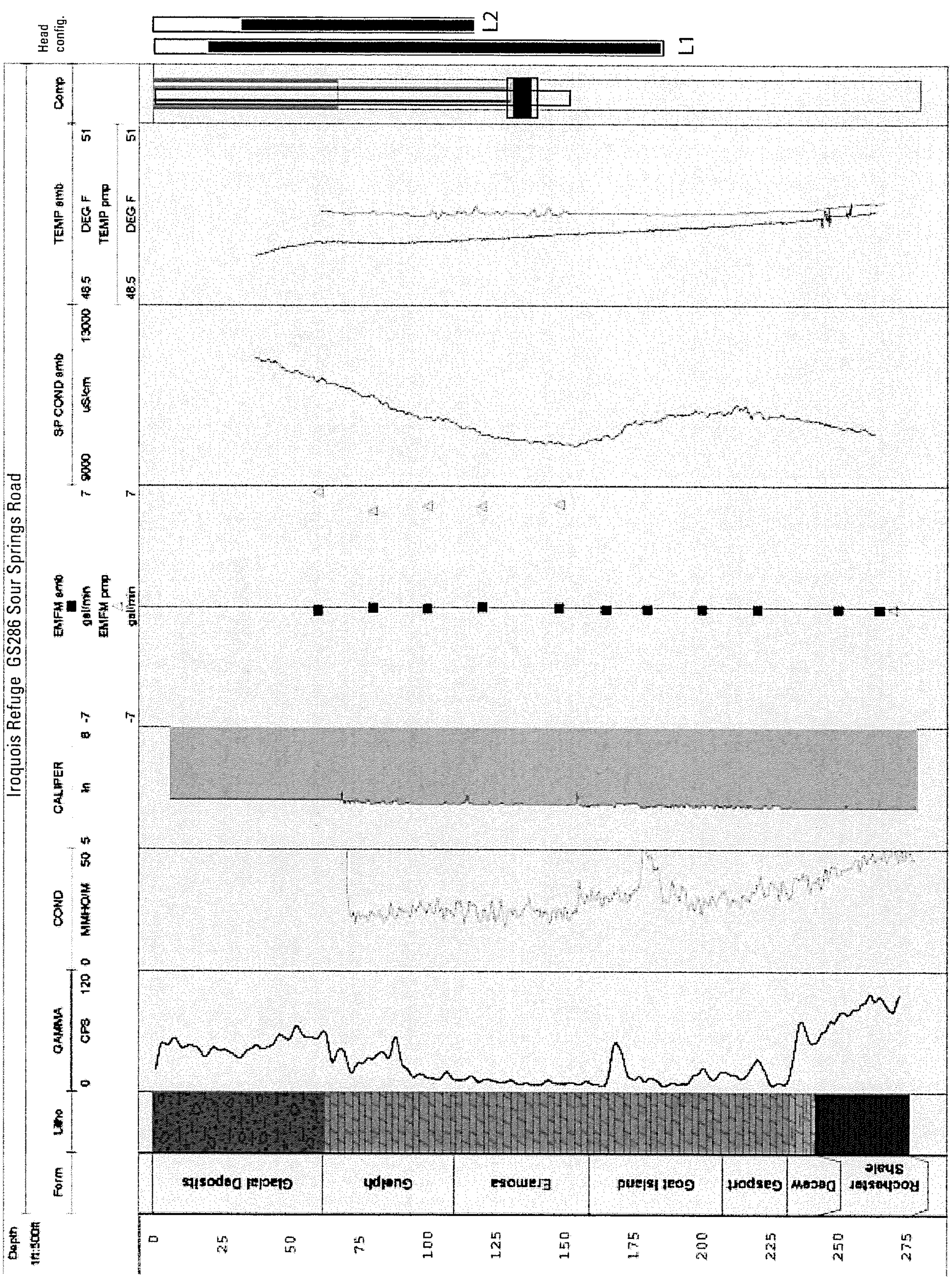


Figure 3–4. Borehole geophysical log for test hole GS286 Sour Springs Road, Genesee County, New York.

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Prepared by the Pembroke Publishing Service Center.

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U.S. Geological Survey
30 Brown Rd.
Ithaca, NY 14850

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(518) 285-5602
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http://ny.water.usgs.gov

USGS

Kappel and Jennings—**Water Resources of the Iroquois National Wildlife Refuge, New York, 2009–2010—Scientific Investigations Report 2012–5027**

Exhibit F

Orleans County Soil & Water Conservation District
446 West Avenue Albion, NY 14411 Phone: (585)589-5959 Fax: (855)347-7122

February 11, 2016

Orleans County Highway Department
Gerald Gray
225 West Academy St
Albion, NY 14411

Dear Mr.Gray,

It was brought to my attention through your Deputy, Mike Cliff, that you were contacted by NYS DEC (Department of Environmental Conservation) because you were cleaning a ditch in an area were threatened/endangered species are located. This ditch is located on East Shelby Road between Fletcher Chapel Road and Posson Road. Mike Cliff gave me the phone number of the DEC agent (Jenny Landri) that contacted you on the issue.

I called Jenny so that she could explain the issue to me. She explained that you were working in an area that the short eared owl nests in the winter months. The juvenile owls nest in grassy areas, such as road side ditches, and has been seen in this area during winter months. Since you were unaware of these species sensitive areas, DEC will not pursue any repercussion from any violations in this area. DEC requests that you check their "environmental resource mapper" before starting excavation projects, to decide if you need a permit for your proposed activities.

After discussing this issue further Jenny explained that we can speed up this process by checking the DEC map and if the project is located in an area where one of these species lives we can call her to see if our activity will need a permit or not.

If you have a list of proposed projects that you would like me to look into for you to make sure that you will not need a permit, feel free to let me know. I know that some projects come up spur of the moment, but if you ever need help trying to move a project along I am more than willing to help.

If you have any questions feel free to contact me.

Katie Sommerfeldt
Technician