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# *SECTION I – IMPACTS AND DANGERS OF BLASTING QUARRIES*

***Flyrock is the dirty little secret of the blasting aggregate industry and the explosives engineers that work on behalf of the aggregate industry in Ontario!***

## *INTRODUCTION*

There is no general provision in the Occupational Health and Safety Act (OHSA), or any Ontario Statute other than section 14 of the Environmental Protection Act (EPA), which prohibits the discharge of rock or any other material that may injure any person, cause damage to property, plant or animal life, interfere with normal course of business or enjoyment of property or adversely affect the environment.[1]

In 1962, blasting from the Dufferin Aggregates Milton Quarry blew a hole in the Niagara Escarpment, one of Southern Ontario's most prominent landscapes. The Escarpment is a major limestone outcrop running through a large part of southern Ontario from Niagara Falls to the Bruce Peninsula. It is simultaneously a site with unique ecological systems, prime agricultural lands, high scenic and amenity value, proximity to urban centres, and valuable aggregate mineral deposits, as well as being significant to local Indigenous communities as traditional territory and for legal, economic, spiritual and historic reasons. The transformation of such a prominent landscape was a catalyst for an emerging environmental movement in the province and for the social and political construction of the Escarpment as a specific and valuable landscape. A 1968 government-commissioned expert report mapped and documented the entire Niagara Escarpment area in response to growing public awareness about the unique features of the area and concern about the impact of the aggregate mineral industry. In 1990, the area was designated as a UNESCO World biosphere reserve.[2][

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[1] *Castonguay Blasting Ltd., v. Her Majesty the Queen in Right of the Province of Ontario*. Respondent's Factum on Appeal, para. 41, SCC File No.34816. https://www.scc-csc.ca/WebDocuments-DocumentsWeb/34816/FM020_Respondent_Her-Majesty-the-Queen-in-Right-of-the-Province-of-Ontario-as-Represented-by-the-Minister-of-the-Environment.pdf.

[2] Estair Suarez Van Wagner, "The Place of Private Property in Land Use Law: A Relational Examination of Ontario's Quarry Conflicts [p.197]," *York University*, August 2017, PhD Dissertation. At p. 349 of the Dissertation, reference is made to Section 2.11 of the Niagara Escarpment Planning Area, which "specifically considers mineral resources, with the objective of minimizing the impact of new mineral extraction and accessory uses."

## *CONFLICTING LAND USES & ADVERSE EFFECTS*

### *Reciprocal Setbacks and Buffers on Incompatible Land Uses*

In *Capital Paving Inc. v. Wellington (County)*, [2010] O.M.B.D. No. 9, the OMB addressed the application of what became para. 1.2 of the 2014 Provincial Policy Statement (PPS) on the buffering of resource extraction activities and sensitive land uses from each other and coordination of uses to prevent adverse effects. The OMB stated that:

> ***While residential sensitive uses would be restricted in locating near to existing or expanding aggregate operations and in the area of known deposits, the PPS also provides protection in buffering or separation when the residential use is in place first … It is fair to say that the PPS speaks to the incompatibility of sensitive residential use with earlier aggregate operations and the reverse is also true that a proposed pit may be incompatible with the prior residential use [para. 16].*** [emphasis added]

Setbacks and buffers are to be applied in a consistent and reciprocal manner to avoid adversely effecting or sterilizing (fully or partially) pre-existing sensitive uses (e.g., residential) on land not under the same control or ownership of the proponent of a proposed offending land use. Land zoned or designated for sensitive uses (e.g. residential) should also be protected by restricting offending (obnoxious) land uses to be established beyond a safe distance of the lot or zoning limits so as not to have the effect of precluding legally permissible uses.

In *Carlyle Development Corp. v. Baldwin (Township)*,[3] the OMB found that the subject matter of s.2.2.6 and 2.2.7 of the Provincial Standards (Aggregate Resources Act) is distinct from the land-use planning issues addressed in policy E.10.2 of the Official Plan. Section 2.2.6 and 2.2.7 of the Provincial Standards addresses issues for the Minister to consider on an application for an aggregates licence, while para. E.10.2 of the Official Plan addresses incompatible uses in the context of land use planning:

> *The Township argued that s. 66(1) of the ARA allows for the coexistence of the ARA, its regulations and the provisions of licences and site plans with municipal by-laws or official plans, unless they deal with the same subject matter. In this regard, it noted that policies 2.2.6 and 2.2.7 of the Aggregate Resources of Ontario, Provincial Standards Version 1.0 (the "Provincial Standards") require that technical reports on noise and blast design be submitted with applications for aggregates licences under the ARA where proposed extraction activities will be within 500 m of a receptor.* ***The Township argued that the 500 m buffer areas in the Provincial Standards address a separate issue from that addressed by the 1,000 m area of influence in the Official Plan. The Township submitted that the subject matter of these Provincial Standards provisions is noise assessment and blast design for the purposes of aggregates licences, while the subject matter of para. E.10.2 of the Official Plan concerns incompatible land uses in areas surrounding industrial-extractive designations for the purposes of land-use planning and does not address aggregates licensing issues****.* [emphasis added]

[3] *Carlyle Development Corp. v Baldwin (Township)*, 2017 CanLII 31075 (ON LPAT), <http://canlii.ca/t/h3x73>, retrieved on 2020-03-29.

In *Matter of Troy Sand & Gravel Co., Inc.* (TS&G) *v. Fleming*,[4] the Appellate Division of the Supreme Court of New York upheld the decision of the Planning Board of the Town of Nassau to deny the proponent a special use permit for a proposed blasting quarry over concerns that the proposed quarry would discourage *appropriate* future development of adjoining land in a *rural residential district* and have a detrimental financial impact on the value of neighbouring homeowners' properties:

> ***The second special use standard requires that "the nature and intensity of intended operations shall not discourage the appropriate development and use of adjacent land and buildings nor impair the value thereof"*** *(Local Law No. 2 [1986] of Town of Nassau art VI [A]* ***[2]). In finding that this standard was not satisfied, the Town Board relied on, among other things, a property value impact analysis, prepared by an expert whose qualifications have not been challenged. The analysis concluded that the proposed quarry would, unequivocally, have a deleterious financial effect on existing homeowners in the surrounding area and could result in a significant decrease in neighboring property values****.*** [emphasis added]

TS&G's proposed quarry, consisting of 214 acres of which 79 acres were to be excavated and blasted in six phases spanning 100 to 150 years, is inconsistent with the long-term objectives of the *Rural Residential District* zoning. Reportedly, the area of the mining activity (excavation and blasting) was to be set back from the property line (lot limit) 200 feet, with the mining activity being no less than 1,210 feet (369 metres) from the nearest *existing* residence:

> *The Rural Residential District is established to maintain and protect the open, rural character, environmental quality and natural habitat of these parts of the town while allowing for a mixture of housing types, opportunities and home occupations and to provide for current and future residents the opportunities for a wide range of activities including rural living, agriculture, forestry, recreation and the enjoyment of wildlife.*

"As-of-right" uses permitted in an *RR-Rural Residential District* include the following, each requiring a minimum lot area of 2 acres:

> *1) Single-family dwelling, 2) Two-family dwelling, 3) Individual mobile home (temporary lincense in all districts), 4) Home occupation I, 5) Agricultural uses, 6) Forestry uses, 7) Plant nursery, and 8) Horse riding/boarding stable*

Some of the reasons cited by the Planning Board for refusing to issue TS&G a permit for a proposed blasting quarry are listed as follow:

- *TS&G's application "would represent a dramatic shift from the development plan set forth by the Town of Nassau and implemented in the 1986 Zoning Law." R. 3837.*
- *"This application has a multitude of combined impacts that represents [sic] a complete violation of the development plan envisioned by the 1986 law….it is not an addition the Town Board considers as a use that protects and furthers the health, safety welfare, comfort or convenience of the public."*
- *"It is also clear that this proposal is not in accord with the land use policies that have been in place for just about 30 years."*

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[4] *Troy Sand & Gravel Co., Inc. v. Fleming*, 156 AD 3d 1295 (2017) 68 N.Y.S.3d 540, 2017 NY Slip Op 09222, https://scholar.google.ca/scholar_case?case=6635546804191739814&q=property+values+near+quarries&hl=en&scisbd=2&as_sdt=2006.

- *"This is a proposal for an industrial hard rock quarry use in a rural residential setting…[t]he Town is therefore being asked to approve what would be a use that would be discordant in the Rural Residential district with existing development…and to impose industrial development upon this area…that is not protective of the health, safety, welfare, comfort or convenience of the public."*
- *"We have reflected on the orderly development of the district and the community character that exists as well as the advancements in positive economic and social development that could exist with our current development trajectory. This project would irreversibly mar this development pattern….[i]t would negatively impact the planned and future development of Town of Nassau as envisioned by the development regulations…"*
- *"We find that the project is a violation of our requirement to honor the laws that have been adopted by and helped to guide Nassau." R. 3837-38.*
- ***"[T]his mine is antithetical to the Town's vision for the area in which the mine is proposed, as that vision is set forth in both the general purposes of the 1986 Zoning Law."** R. 3888.[5] [emphasis added]*

Quarries[6] can conflict with existing land uses, and have adverse environmental, physical, social and economic impacts on the surrounding environment and its inhabitants. Land use controls are an effective way of minimizing conflicts between competing land uses and avoiding adverse effects.

In discussing the role of zoning in avoiding conflicting land uses, the Supreme Court of Canada in *Saint-Romuald v. Olivier*[7] makes reference to private law remedies designed, in a general sense, to protect neighbourhood amenities from damaging externalities occasioned by intruding non-compatible and undesirable land use activities:

> *The doctrine of Rylands v. Fletcher (1868), L.R. 3 H.L. 330, imposes virtually absolute liability on owners who bring on their land "anything likely to do mischief if it escapes" and causes damage to a neighbour, unless the escape was due to the neighbour's default (pp. 339-40) [para. 9].*

As noted by the OMB in *Caldwell Construction Ltd. v. Kirkland Lake (Town)*,[8] the objective of land use planning is to avoid adverse effects by separating incompatible land uses or incompatible activities:

> *Land use planning differentiates and separates incompatible uses to prevent or minimize adverse effects on the persons occupying those land uses. The individual characteristics of the current occupants of a land use do not set the standard for establishing an adverse effect. The standard is more general and relates to an assessment of compatibility between two land uses such that persons generally may occupy those uses without adverse effects [para. 70].*

Setback requirements prohibiting quarry uses, regardless of whether blasting is involved and only permitting quarrying by special permit, are not preempted because setbacks are

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[5] https://www.couchwhite.com/wp-content/uploads/2017/06/Time-Stamped-Amici-Curiae-Brief.pdf.

[6] Quarries mine consolidated bedrock, such as shale, limestone and dolostone. Blasting is required to dislodge material from the working face; crushing machines are required on a full time basis to break down the material into smaller pieces; and, when working below the water table, dewatering is required to keep the excavation area dry.

[7] *Saint-Romuald (City) v. Olivier*, 2001 SCC 57 (CanLII), [2001] 2 SCR 898, <http://canlii.ca/t/51z2>, retrieved on 2020-01-09.

[8] *Caldwell Construction Ltd. v Kirkland Lake (Town)*, 2018 CanLII 58222 (ON LPAT), <http://canlii.ca/t/hsqcr>, retrieved on 2020-01-11.

traditional land use regulations.[9] Setbacks are controlled through enactment of zoning by-laws at the municipal level. A zoning by-law:[10]

- *implements the objectives and policies of a municipality's official plan (See section 2, Official plans)*
- *provides a legal way of managing land use and future development*
- *in addition to the official plan, protects you from conflicting and possibly dangerous land uses in your community*[11]

Pursuant to the *Regulation respecting pits and quarries.* (Q-2, r. 7), Quebec has a prohibition against establishing a new quarry on or within 600 metres of land zoned for *residential*, *commercial* or *mixed commercial-residential* use, so as to separate incompatible land uses and avoid externalizing potential adverse effects or sterilizing the use of land (i.e., private property) beyond the lot limits of a proposed quarry:

> ***Zoning:*** *It is prohibited to establish a new…quarry, the operating site of which is located in a territory zoned by the municipal authorities for residential, commercial or mixed purposes (commercial-residential). It is also prohibited to establish a new quarry less than 600 m from such territory…(R.R.Q., 1981, c. Q-2, r. 2, s. 10.).*

Courts have ruled it unlawful to enact a zoning by-law for the exclusive benefit of a proposed quarry operation by imposing setback (buffer) requirements on neighbouring lands which restrict or preclude their development (i.e., de facto taking of land without compensation) and which impose (externalize) unwanted adverse impacts. Any burdens imposed on a proposed quarry operation, including setback requirements, to avoid adverse impacts must be borne entirely by the proponent and confined within the boundaries of the proposed offending quarry. Neighbouring property owners are not legally bound to subsidize a for-profit quarry operation, nor are they expected to endure the adverse impacts of a quarry operation (e.g., blasting - a hazardous activity, flyrock, concussion, vibration, noise, odour, pollution, loss of access to groundwater - a property right, truck traffic, personal injury, respiratory illnesses, property damage, reduced property value, etc.):

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[9] *Tinicum Tp. V. Delaware Valley Concrete*, 812 A. 2d 758 Pa.Commw. Ct. 2002, https://scholar.google.com/scholar_case?case=15752167703902735334&q=tinicum+tp+v+delaware+valley+concrete&hl=en&as_sdt=2006.

[10] https://www.ontario.ca/document/citizens-guide-land-use-planning/zoning-bylaws.

[11] **Hazardous** sites: means property or **lands** that could be **unsafe** for development and site alteration due to naturally occurring **hazards**. These include unstable soils (sensitive marine clays [leda], organic soils) or unstable bedrock (karst topography), October 23, 2015, p. 1491 www.mah.gov.on.ca. ***Blasting*** is an ultrahazardous activity, and "[w]hen one engages in the inherently dangerous operation of blasting with dynamite under such conditions that the person or property of another is necessarily or obviously exposed to the danger of probable injury, he does so at his peril. He is absolutely liable for damages which result from the blasting whether he was negligent in his conduct of the operation or not. [W]here the damage resulting from the explosion has been caused, not by flying rocks, but by concussion of the atmosphere or vibration of the earth, the rule is none the less applicable. *Whitman Hotel v. Elliott Watrous Eng. Co.*, 137 Conn. 562 (Conn. 1951) 79A.2d.59.
https://scholar.google.ca/scholar_case?case=17862617283316607906&q=Whitman+Hotel+Corp+v.+Elliott+%26+Watrous+Eng%27r+Co&hl=en&as_sdt=2006&as_vis=1.

***Kozesnik v. Montgomery Twp.*:**[12] *Hillsborough manifestly found that quarry operations hold a significant potential for deleterious influence upon the enjoyment of neighboring property. This is at least one basis of the acreage requirement and is the basis of the restrictions recited at the outset of this opinion fixing certain distances between phases of the operations and homes. The difficulty is that protection is afforded only for "any dwelling existing at the introduction of this ordinance." The owners of the remaining acreage are entitled to like protection to the end that the authorized uses may reasonably be pursued. The record does not clearly reveal the precise location of the parcels not controlled by 3M. We gather there are five such parcels, of which four are unimproved (the fifth, owned by plaintiffs, Slover, is largely in another zone with a small triangular rear portion jutting into the limited industrial zone). The exact location of 3M's holdings was frankly obscured for private reasons not here pertinent. But whatever the physical relation of the other parcels to 3M's, it is plain that under the ordinance 3M could carry on its activities within the very distances of those parcels which Hillsborough has found to be necessary to protect housing use.*

*We are not here concerned with that incidental and unremediable loss of value which is inevitably experienced by property abutting another zone in which lesser uses are authorized and which must be accepted for the common good. Guaclides v. Borough of Englewood Cliffs, 11 N.J. Super. 405, 414 (App. Div. 1951); Gross v. Allan, 37 N.J. Super. 262, 270 (App. Div. 1955). Rather,* ***we have a situation in which some property owners are required for the special benefit of another proprietor to absorb part of the burden of an industrial use of acknowledged capacity to harm, and this upon the irrelevant circumstance whether their properties are or are not improved at the time of the introduction of the ordinance. The imposition is unreasonable and the classification arbitrary****.* [**emphasis added**]

***It is true that where a nuisance results, it is no defense that the zoning ordinance authorized the operation and hence judicial relief may be had****. Kosich v. Poultrymen's Service Corp., 136 N.J. Eq. 571, 584 (Ch. 1945).* ***Nonetheless, when a zoning ordinance is being prepared, and as here the potential nuisance is recognized unless the operation be isolated, the ordinance should require the quarry operator to provide the necessary buffer and not cast the burden on the neighboring owner. If the ordinance expressly said that a property owner may not improve his land within a given distance of the quarry or processing plant, the appropriation of his property for the benefit of the quarry operator would be apparent****. Cf. Raskin v. Town of Morristown, supra (21 N.J. 180).* ***Principle is no less offended when the ordinance purports to place the burden upon the quarry operator but as a practical matter transfers it to neighboring owners who, while ostensibly permitted to utilize their properties, must provide their own setbacks or experience an exposure capable of hindering enjoyment. Whatever the reasonable distances may be, they should be measured from adjoining property lines whether or not the parcels are now improved****.* [**emphasis added**]

***Kozesnik complains that his property cannot be put to the single authorized use since he cannot associate it with a quarrying operation in Hillsborough and hence the ordinance is invalid as to his property. It was frankly conceded before us that there is nothing he can do with his property. That a restraint against all use is confiscatory and beyond the police power and statutory authorization is too apparent to require discussion****.* [**emphasis added**] *Grosso v. Board of Adjustment of 183*183 Tp. of Millburn, 137 N.J.L. 630 (Sup. Ct. 1948); Arverne Bay Construction Co. v. Thatcher, 278 N.Y. 222, 15 N.E.2d 587, 117 A.L.R. 1110 (Ct. App. 1938); 2 Metzenbaum, Law of Zoning (2d ed. 1955), p. 1416 et seq.*

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[12] *Kozesnik v. Montgomery Twp.*, 131 A, 2d 1, 24 NJ 154 (1957), https://scholar.google.com/scholar_case?case=8002546886091518038&q=kozesnik+v+montgomery+twp&hl=en&as_sdt=2006. See also "Zoning Buffers: Solution or Panacea," *American Society of Planning Officials* (April 1960): 13-15, https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/pas/at60/pdf/report133.pdf.

In *Eastman et al. v. Dewdney Mountain Farms Ltd.*,[13] local residents filed an appeal seeking to set aside three OMB decisions pertaining to Trent Lakes' Official Plan and Zoning By-laws in connection with a proposed limestone quarry. On the issue of whether the OMB erred in proposing *noise mitigation measures without evidence supporting their feasibility*, the Divisional Court found in favour of the residents. As noted by the court, and conceded by *Dewdney,* a zoning by-law amendment conditional on a Haul Route Agreement being executed by "relevant parties" would not ordinarily encompass private land owners, whose land cannot be used by *Dewdney* to mitigate *adverse impacts* outside of the lot limits of the proposed quarry, without the consent of the impacted property owners. On this one issue, the case was sent back to the OMB.

At the OMB hearing that followed,[14] it was acknowledged that the Board previously hearing the case "failed to appreciate that the ARA will not permit…issuance of an aggregate extraction license unless and until the lands for which it is to be issued are actually zoned, by an in-force by-law, to permit aggregate extraction." In addressing the issue of *noise mitigation*, ultimately 9 sensitive receptors were identified along the proposed haul route that would experience unacceptable levels of noise, and there was consensus to recognize the hunting camps as sensitive receptors.

> *The parties agreed that the core issue in this hearing was the potential for adverse impact on the residential dwellings fronting on Ledge and Quarry Roads from the noise created by trucks using the portion of the proposed haul route on Ledge and Quarry Roads [para. 36], [and]*
>
> *[That] the Appellants…contend that the increased noise, dust and heavy truck traffic will have an unacceptable adverse impact both on their property values and on their quality of life [para. 37].*

Consequently, some form of mitigation is required in order to comply with section 2.5.2.2 of the Provincial Policy Statement,

> *which declares that extraction shall be undertaken in a manner which minimizes social, economic and environmental impacts, and…[which] compl[ies] with the applicable noise guideline documents published by the Ministry of the Environment…[para. 32].*

But for the proposed quarry use, heavy quarry trucks would not be on Ledge and Quarry Roads, and without a means of access for heavy trucks to haul aggregate the proposed quarry cannot function. In the initial mitigation proposal submitted by Mr. Hofbauer, the applicant's acoustical engineer,

> *it appears that what was then contemplated in the way of mitigation was the emplacement of earth berms and noise walls atop them, to be strategically placed along Quarry Road and Ledge Road so as to attenuate the sound energy which would be experienced at the various sensitive receptors and bring that sound energy down below the recommended maxima.*

It became evident that the ill-defined, impractical and presumptuous nature of this conceptual mitigation measure, dependent on the property rights of others, was not acceptable to the impacted property owners along the proposed haul route:

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[13] *Eastman, Johnson, Klein and Pillsworth v. Dewdney Mountain Farms Ltd*., 2017 ONSC 5749 (CanLII), <http://canlii.ca/t/h6fbf>, retrieved on 2020-01-15.

[14] *Anderson v Trent Lakes (Municipality)*, 2018 CanLII 35131 (ON LPAT), <http://canlii.ca/t/hrnfd>, retrieved on 2020-01-15.

> *…[I]n order to implement such a feature, it may be necessary to enter upon the private property to be protected in order to create a portion of the berm….[T]he Tribunal…[was advised] that the owners of the affected properties are not prepared to grant the necessary consent for such entry and works. Therein lay the issue of feasibility [para. 34].*
>
> *The Appellants are of the view that they are entitled to legitimate protection that can and will be implemented. They should not have to take on faith that some means will be determined to shield their properties. They should have the benefit of a detailed plan so that all of the ramifications of the proposal can be assessed [para. 35].*

A new mitigation plan submitted by the acoustical engineer would have resulted in an uninviting barricading effect on the properties of the impacted owners:

> *The new scheme would create a noise attenuation barrier in the form of armourstone walls which would be located wholly within the road allowance. These would be supported by earth berming on Ledge Road. In order to have room to accommodate these works wholly within the road allowance, the road would have to be reconstructed away from the affected private properties and off-centre of its current location, which the Tribunal understands to presently be generally centred on the road allowance. For those properties on Quarry Road, due to the location of sensitive receptors on both sides of the road, and due to the resultant physical constraints which arise from that in terms of realigning the road, in lieu of earth berming, gabion works are suggested to provide the necessary support for the armourstone walls [para. 39].*
>
> *The armourstone walls would be constructed in layers or courses, each approximately 1 metre…in height. The table by Mr. Hofbauer indicated various proposed heights to achieve the necessary mitigation at each particular location. The heights run from a low of 2.5 m [8.2 feet] to a high of 4 m [13.12 feet]. Thus, at certain locations, the armourstone wall would be three layers [9.84 feet] and in others four [13.12 feet] [para. 40].*

Mr. Hofbauer acknowledged that there would have to be breaks in the armourstone walls where the property owners' driveways are located, at which points there would be an increase in the decibel level, something not apparent in the engineer's calculations. He acknowledged not working from final road designs, and that his sound mitigation values were only theoretical. Further, there was no agreement in place with the Town that would allow for the works contemplated by the acoustical engineer. The shortcomings of this ill-conceived mitigation plan are readily apparent:

- an increase of 1 decibel at each opening (driveway) would in every case exceed the recommended noise limit
- adequacy of sight lines to ensure safe movements from the driveways resulting from 3-metre (9.84 feet) to 4-meter (13.12 feet) high walls set within the abutting road allowance
- no indication of how the presence of the walls would affect snow removal
- no provision for the location of utility poles
- no provision for drainage swales or other means of storm drainage

In short, none of the affected property owners would know the precise features of the noise mitigation abutting their property and, therefore, would not be able to assess the impacts of those features on the use and enjoyment of their property.

Furthermore, it is highly improbable that the provision for utility poles and drainage swales (or other means of storm drainage) as part of the conceptual mitigation plan could be achieved without expropriating land from the impacted property owners along the

proposed haul route, a power not available to a private for-profit corporation or entity. In rejecting the conceptual nature of the proponent's mitigation plan, and setting aside the Zoning Amendment, the OMB found that,

> *The evidence tendered by the Proponent…falls well below the standard necessary to satisfy the Tribunal that the required noise mitigation works are feasible and capable of implementation so as to achieve the required noise attenuation objectives and also not creating ancillary undue impacts either as such impacts may relate to the functioning of the road itself or the use and enjoyment of the properties abutting thereon [para. 58].*
>
> *Having come to the conclusion that there is insufficient evidence at the present time to be assured that there will be efficacious noise mitigation to the affected sensitive receptors on Ledge Road and Quarry Road, and that policy compliance requires such assurance, the Tribunal cannot, in the public interest, authorize the use of the Site for quarry purposes [para. 60].*

While the OMB ruled in favour of the property owners, the decision does not address the likely costs of the works associated with the noise mitigation measures, the cost of maintaining the haul routes, exposure to dust and exhaust fumes from truck traffic and potential health risks, increase in traffic and potential fatalities, ground vibrations from truck traffic, and the likely diminution in the value of the impacted properties, accompanied by a reduction in the Town's tax base. Under the Ontario *Municipal Act, 2001,* municipalities enjoy broad powers as to the manner in which they govern their affairs and over issues that impact property and persons within their municipal boundaries:[15]

- Section 8 of the *Municipal Act, 2001* provides that the powers of a Municipality under this or any other Act shall be interpreted broadly so as to confer broad authority on municipalities to enable them to govern their affairs as they consider appropriate, and to enhance their ability to respond to municipal issues.
- Section 9 of the *Municipal Act, 2001* provides that a Municipality has the capacity, rights, powers and privileges of a natural person for the purpose of exercising its authority under this or any other Act.
- Section 10 of the *Municipal Act, 2001* provides that a Municipality may pass by-laws respecting: Economic, social and environmental well-being of the Municipality; Health, safety and well-being of persons; Protection of persons and property; Structures, including fences and signs.
- Section 128 of the *Municipal Act, 2001* provides that, without limiting sections 9 and 10, a local Municipality may prohibit and regulate with respect to public nuisances, including matters that, in the opinion of Council, are or could become or cause public nuisances, and the opinion of Council under this section, if arrived at in good faith, is not subject to review by any court.

In *Bowen et al. v. Bedford et al.*,[16] there was a dispute as to whether a *limestone quarry* is a permitted use in an *RF-Rural* zone, as well as on all *zoned* land in the City of Saint John. The majority of the New Brunswick Assessment and Planning Appeal Board (NBAPAB) sided

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[15] For example, see Public Nuisance By-law PH-18, Bill No. 228, 2012 – Consolidated as of August 27, 2019, City of London, https://www.london.ca/city-hall/by-laws/Documents/public-nuisancePH18.pdf.

[16] *Bowen et al. v. Bedford et al*, 1992 NBAPAB 20 (CanLII), <http://canlii.ca/t/26cpw>, retrieved on 2020-01-12.

with the City (Development Officer), which recognized a limestone quarry as a permitted use both under the *RF Rural* zoning, as well as in all zones.

However, the minority opinion rejected the majority view that, implicitly, limestone quarrying is permitted in all zones, distinguishing limestone quarrying as a *main* use, unlike the kind of *grading, excavation for a basement or swimming pool, work performed by a public utility or the construction, repair or alteration of streets*, which are either incidental to the main use of the land or necessary for the public good. Moreover, the majority's view runs counter to the theory behind zoning and the issue of land compatibility, with the welfare and stability of the community taking priority over profit maximization of an individual's or corporate entity's desired use of land.

> *Commercial limestone quarrying…is the main use of the land and is also a private undertaking which, in my opinion, places it in a separate category from the other types of excavation listed in Section 880(2). These factors make it a very different type of excavation and not one which I would imagine Council intended to be permitted in every zone. If they did, they should have been more specific in saying so.*
>
> *The* ***necessity*** *for allowing the other types of excavation in any zone is self-evident. Such is not the case with respect to commercial limestone quarrying in my opinion. I am fortified in this conclusion by the fact that it is specifically made subject to terms and conditions which the PAC may impose and in fact it may even be prohibited by the PAC. Excavations for streets, foundations and swimming pools are not conditional uses, nor may they be prohibited by the PAC under any circumstances.*
>
> *The Community Planning Act provides in Section 34(4)(c) that a zoning by-law may prescribe particular purposes for which land, buildings and structures in any zone may be used in respect of which the PAC may impose terms and conditions or, alternatively if, in the PAC's opinion, compliance with the terms and conditions cannot reasonably be expected the PAC may prohibit the use. These uses are known as conditional uses. An example may be found in Section 720(1)(b) as set out in Schedule "B" hereto.*
>
> *The Act also provides in Section 35(a) that if, in the opinion of the PAC, a use which is otherwise not permitted under the zoning by-law is sufficiently similar to or compatible with any use which is permitted in the zoning by-law, then that similar or compatible use may be permitted by the PAC subject to terms and conditions.*
>
> *These provisions of the Act and the by-law which allow the PAC to impose terms and conditions on uses also envision a determination of compatibility with uses in the affected zone. With respect to the conditional use, the compatibility aspect presumably has been considered by Council when the by-law was passed. With respect to the similar use, the Act contemplates the PAC determining the compatibility issue.*
>
> *Section 40(2) of the zoning by-law also authorizes the PAC to allow a development otherwise prohibited by the by-law for a temporary period not to exceed one year subject to terms and conditions. This too allows for consideration of the compatibility issue which, in my opinion, is so central to the concept of zoning, before approval is given.*
>
> ***If commercial limestone quarrying or any main use were allowed by necessary implication in any zone, as suggested by the respondent, then the compatibility factor would be overlooked and in my opinion, that would be contrary to the whole theory of zoning***. [emphasis added]

The minority cites Roger's description of *zoning* in Corpus Juris Secundum at pages 115-116, as

> *…the regulation by districts of the building development and uses of property, and its essence is a territorial division according to the character of lands and structures and their peculiar suitability for particular uses, and the uniformity of use within the division.*

> *Zoning is a deprivation for the public good of certain uses by owners of property to which the property might otherwise be put. Underlying planning statutes is the principle that the interest of landowners in securing the maximum value of their land must be controlled by the community.*
>
> *The theory of zoning is that each district is an appropriate area for the location of certain uses which the plan designates, and the existence or entrance of other uses will tend to impair the development and stability of the area for the appropriate uses. The objective of zoning must be considered from the standpoint of the public welfare and of all the property within any particular use district.*

Applications for new quarries in Ontario[17] ought not to be approved and expansion of existing quarries denied if a quarry operation cannot be adequately setback *inside* the boundary limits of the property and guaranteed to:

- *avoid conflict and incompatibility with existing sensitive land uses*,[18]
- *not endanger the health and safety of the public*,[19] [20]

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[17] In Ontario, permits and licenses are issued by the Ministry of Natural Resources and Forestry (MNRF) pursuant to the *Aggregate Resources Act*, R.S.O. 1990, c. A.8. A listing of all licenced/permitted pits and quarries in Ontario and a number of related resources can be downloaded from the government's website: https://www.ontario.ca/rural-and-north/aggregate-resources-policies-and-procedures. For a detailed analysis of the aggregate industry in Ontario see Estair Van Wagner's 2017 dissertation: https://yorkspace.library.yorku.ca/xmlui/bitstream/handle/10315/35453/Van_Wagner_Estair_S_2017_PhD.pdf?sequence=2&isAllowed=y.

[18] "**Sensitive land uses:** means buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more *adverse effects* from contaminant discharges generated by a nearby *major facility*. *Sensitive land uses* may be a part of the natural or built environment. Examples may include, but are not limited to: residences, day care centres, and educational and health facilities. [p. 48]" *Provincial Policy Statement*, 2014. http://www.mah.gov.on.ca/AssetFactory.aspx?did=10463.

[19] "An air quality index (AQI)…[measures] current air status and is used to forecast how it becomes….As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects….Blasting and crushing of crystalline rocks generates dust (particulate matters) presence in the immediate and nearby environment. This alters the ambient air quality with its attendant geohazards such as visual impairment, noise, segmental vibration, heat, changes in barometric pressure and ionizing radiation…[and] water pollution is exacerbated due to dust generated by quarry activities….Suspended particulate matter is quite outstanding among all pollutants emanating from quarrying operations…There is a clear connection between exposure to the dust and diseases, where exposure to silica dust during stone crushing in quarries carries the risk of development of silicosis, progressive massive fibrosis, asthma, chronic obstructive pulmonary diseases, and airway obstruction in exposed workers [p. 1828]." https://www.ijser.org/researchpaper/Estimation-of-Air-Quality-Status-due-to-Quarrying-activities-and-its-Impacts-on-the-Environment-and-Health-of-the-People.pdf.

[20] In 2014, Oxford County Public Health conducted a survey of Beachville area residents as to *perceived air quality*. A total of 103 self-administered surveys were completed, and almost 72% of respondents reported air quality in Beachville area as "poor" or "very poor." On the open-ended portion of the survey, comments confirmed frustration with "the lack of commitment to the *Source Emissions Monitoring Program* demonstrated by quarry operations, namely, Carmeuse, LaFarge, and Federal White, and…disappointment with the Ministry of the Environment and Climate Change for creating the program then failing to enforce it." As to the impact of air quality on health, 34.9% indicted that their health or the health of a family member had been affected and 16.0% said no, while the remaining 49% didn't know/not sure or did not respond. In rating the air quality as "poor," 15 respondents referenced "visible air pollution, dust, clouds blowing across the road, and respiratory symptoms upon acute exposure to air in the area." Another 29 responses indicated "Poor Health Outcomes," with the majority alluding to "respiratory conditions, such as asthma, chronic obstructive pulmonary disease (COPD), emphysema, and lung disease. Non-respiratory chronic conditions were also reported, including multiple sclerosis, cardiovascular disease, and chronic headaches. A long history of allergies and non-specific symptoms, such as sore, itchy eyes; congestion; cataracts; coughing;

- *not endanger wildlife and livestock,*[21] [22]
- *preclude environmental damage,*[23] [24]

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shortness of breath, and increased phlegm production was reported to affect the lives of several respondents and their families." Although not asked to identify the factors contributing to air quality, 12 respondents "pinpoint[ed] local quarries as a source of poor air quality in the region, thereby, impacting on human health." [emphasis added] http://www.oxfordcounty.ca/Portals/15/Documents/SpeakUpOxford/2015/Beachville/Citizen%20Survey%2020150206.pdf. See also audio presentation of final report on Beachville area air quality report: http://www.oxfordcounty.ca/Your-Government/Speak-up-Oxford/Campaign-Details/ArticleId/5648/2016-DRAFT-Beachville-area-air-quality-assessment.

[21] "**Adverse effects:** as defined in the *Environmental Protection Act*, means one or more of: impairment of the quality of the natural environment for any use that can be made of it;…[p. 38]" *PPS*, 2014. For example, see "Endangered species protection and evidence-based decision making: Case study of a quarry proposal in endangered turtle habitat," *Global Ecology and Conservation* (Volume 20, October 2019) https://www.sciencedirect.com/science/article/pii/S2351989419303555?via%3Dihub.

[22] Endangered Species Act, 2007, as amended, which "takes note of the precautionary principle," https://www.ontario.ca/laws/statute/07e06. See also Species at Risk Act (S.C. 2002 c. 29) https://laws-lois.justice.gc.ca/eng/acts/s-15.3/.

[23] In rejecting JDCL's proposed (blasting below the watertable) quarry, section 12(1)(k) of the ARA required the Board to have regard to "such other matters as are considered appropriate," it must have regard to the cost of mitigation measures and who will bear the costs of them. The Board is cognizant of the fact that all parties have agreed that an unmitigated quarry is inappropriate for the site. The Board would go further to find such an unmitigated quarry would, without a doubt, result in a catastrophe for water dependent natural heritage features and functions around the site…[F]rom all the evidence adduced by all the parties…the only thing standing between the proposed quarry and a catastrophic impact on the environment is the AMP [Adaptive Management Plan]. Therefore the Board must be convinced that the applicant would have the resources to complete all that is required by the AMP ….[In 2003], the present value of those costs was in the range of $80 million to $90 million…[and] that over time, if it was spread out, it would be much more. The Board finds that no public authority, not the Province, the Region, the Town, nor the CVC should ever find itself responsible for the costs of mitigation measures for the proposed quarry…[The] complex, highly engineered closely monitored mitigation system…would have to operate effectively for approximately 80 years [p. 72-73] OMB Decision Nov. 12, 2010 (PL000643 and PL060448) http://gravelwatch.org/wp-content/uploads/2016/03/OMB-Rockfort.pdf. [emphasis added]

[24] Southern Ontario has lost over 72% of its wetland cover, of which aggregate extraction accounted for 6% of the total loss during the period of 2000 to 2010. "Wetlands can store water, acting like a sponge during wet periods and gradually recharging groundwater, which in turn replenishes soils and streams across the larger landscape. Wetlands provide critical reservoirs during storms and heavy rains, protecting us from the worst impacts of floods. Wetlands can stabilize shorelines and control erosion, protecting both the land and water quality. They purify water by filtering out nutrients, sediments and pollutants from groundwater and surface runoff before discharging it to other water bodies. Wetlands also provide habitat for many species of plants and animals, including an estimated 20% of Ontario's species at risk [footnote omitted]. For all these reasons, both the federal and provincial governments have recognized that conserving and enhancing wetland habitat is vital for supporting Canada's actions to sustain biodiversity [sec. 1.1.2]," The cumulative impacts of human activities through repeated and multiple disturbances have led to greater wetland loss or degradation than any threat on its own. "The fate of individual wetlands is often determined on a case-by-case basis, and overall wetland cover is declining due to a slow death by a thousand cuts [sec. 1.2.1]." MNRF released a Wetland Conservation Strategy in 2017 containing 67 promised actions including halting of net loss of wetland area and function by 2025, and achieving a net gain of wetland area and function by 2030, both in areas where wetland loss has been greatest, with reports published every five years, beginning in 2020 (sec. 1.3). Wetlands should be identified as significant until proven otherwise. "Various stakeholders have suggested taking such a ***precautionary approach***: treat all wetlands in southern Ontario as provincially significant until proven otherwise," placing the "burden on the company or person who wants to interfere with a wetland [Chapter 1, p. 23]." [emphasis added] *2018 Environmental Protection Report*, Environmental Commissioner of Ontario. https://docs.assets.eco.on.ca/reports/environmental-protection/2018/Back-to-Basics-Volume4-Ch1.pdf.

- *preclude damage to buried pipelines and utilities*[25] *and above-ground utilities,*
- *preclude damage to wells or aquifers,*[26]
- *preclude damage to personal and real property,*[27]
- *preclude sterilization of adjoining lands,*[28]
- *preclude reduction in value of neighbouring properties,*[29] [30] *and*
- *preclude cumulative effects.*[31]

## *Planning Authority Fails to Consider Competing Interests*

The Planning Authority failed to consider competing interests of the Community under Ontario's Provincial Policy Statement (PPS). As mandated by the OMB, a planning authority cannot disregard the competing interests of the community at the behest of the aggregate industry while addressing and weighing land use policies and options:[32]

> *The PPS mandates that that all relevant policies must be considered by the planning authority.*[33] *The Ontario Municipal Board found in Ontario (Ministry of Natural Resources)…that Part lll of the PPS makes it "abundantly clear" that a planning authority must consider all relevant interests, and*

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[25] Sushil Bhandari and Sheetal Jain, "Managing Social and Environmental Issues Due to Blasting Operations," http://earthresourcetechnology.com/downloads.aspx.

[26] Ibid p. 3.

[27] *PPS* Section 1.1.1(c) states that "Healthy, liveable and safe communities are sustained by…avoiding development and land use patterns which may cause environmental or public health and safety concerns.

[28] Adjoining land zoned or designated to permit legal uses that would be precluded if a new quarry were permitted or an existing quarry were allowed to expand—a de facto taking of land without compensation.

[29] In *Lambrecht v. County of Will*, 217Ill. App. 3d 591 (Ill. App. Ct. 1991, 577 N.E.2d 789, while upholding the trial court's ruling to deny a quarry permit, agreed with the plaintiff's position that "restrictions of the use of property cannot be justified by the mere *desires* of neighbors or their *belief* that property values will be affected. However, the diminution of property values within a neighborhood is a proper factor for the trial court to consider. (See *La Grange State Bank,* 75 Ill.2d at 309, 388 N.E.2d at 391; *Amalgamated Trust Savings Bank v. County of Cook* (1980), 82 Ill. App.3d 370, 382, 402 N.E.2d 719, 727 ('[t]he rights of adjacent and abutting property owners are to be considered') Moreover, regardless of the merits of the distinction drawn by Gorte between people who build their homes near existing quarries and those who buy their homes and "then have a quarry put in [their] back yard," there is nothing in the record to suggest that the trial court based its decision on, or was even influenced by, a similar concern." https://scholar.google.com/scholar_case?case=13855044279831539095&q=lambrecht+v+county+of+will&hl=en&as_sdt=2006.

[30] Emil Malikov, Yiguo Sun and Diane Hite, "(Under)Mining Local Residential Property Values: A Semiparametric Spatial Quantile Autoregression," *Journal of Applied Econometrics* (June 22, 2018): 82-109. https://onlinelibrary.wiley.com/doi/epdf/10.1002/jae.2655.

[31] A Cumulative Environmental Assessment (CEA) is typically expected to "assess effects over a larger (i.e., 'region') area that may cross jurisdictional boundaries; [Includes effects due to natural perturbations affecting environmental components and human actions.], assess effects during a longer period of time into the past and future; consider effects on Valued Ecosystem Components (VECs) due to interactions with other actions, and not just the effects of the single action under review; include other past, existing and future (e.g., reasonably foreseeable) actions; and evaluate significance in consideration of other than just local, direct effects. https://www.ceaa.gc.ca/default.asp?lang=En&n=43952694-1&toc=show&offset=6. See also August 11, 2014 Brampton Recommendation Report recommending against rezoning to permit a shale quarry and related uses citing a number of adverse effects and potential risks and cost implications for the City of Brampton and Region of Peel, https://www.brampton.ca/EN/City-Hall/meetings-agendas/PDD%20Committee%202010/20140908pdd_G6.pdf.

[32] *Kevin Matthews et al v. Lempiala Sand & Gravel Limited*, File no. PL180754, https://www.cela.ca/sites/cela.ca/files/TLCA%20Case%20Synopsis.pdf.

[33] *PPS*, Part lll, policy 4.4.

> *that all policies must be considered and weighed when land use decisions are to be made [para. 30].*[34]
>
> *The phrase "as is realistically possible" in section 2.5.2.1 of the PPS means that a proposal for aggregate must address competing interests:*
>
> > The "as is realistically possible" approach means addressing competing interests of many stakeholders, one of which is the aggregate industry. With respect, it would be an oversimplification of the policy and an error of interpretation in my estimation to suggest that "as is realistically possible" only includes the physical existence of the aggregate resource.[35] [para. 36]
>
> *Ontario's Planning Act, and the PPS and the Official Plan applicable in the unorganized township of Gorham, stress balance and compatibility between land uses.* ***Contrary to that mandatory direction, the LRPB [Lempiala Sand & Gravel Limited] focused solely on the provisions of the planning documents which support aggregate extraction [section 2.5] and did not consider the provisions which support recreational and residential land use, and environmental protection*** *[para. 3].* [emphasis added]

Section 1.2.6 of the 2014 Provincial Policy Statement (*PPS*)[36] sets out the provincial expectation when planning for major facilities such as a quarry in proximity to sensitive or incompatible land uses:

> *Major facilities and sensitive land uses should be planned to ensure they are appropriately designed, buffered and/or separated from each other to prevent or mitigate adverse effects from odour, noise and other contaminants, minimize risk to public health and safety, and to ensure the long-term viability of major facilities.*

The *PPS* takes its definition for "adverse effects" from the Ontario *Environmental Protection Act* (EPA), and includes one or more of the following factors:

*a) impairment of the quality of the natural environment for any use that can be made of it,*
*b) injury or damage to property or to plant or animal life,*
*c) harm or material discomfort to any person,*
*d) an adverse effect on the health of any person,*
*e) impairment of the safety of any person,*
*f) rendering any property or plant or animal life unfit for human use,*
*g) loss of enjoyment of normal use of property, and*
*h) interference with the normal conduct of business.*

The *PPS* policies flow from the provincial interests articulated in s.2 of the *Act*, including,

*i) "(h) the orderly development of safe and healthy communities" and*
*j) "(o) the protection of public health and safety"*

The *PPS* must also be read in conjunction with s.14(1) of the EPA:

> *…a person shall not discharge a contaminant or cause or permit the discharge of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect.*

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[34] *Ontario (Ministry of natural Resources), Re,* 2012 CarswellOnt 10693, at para 25 [*Ontario (MNR)*], in TLCA Book of Authorities, Tab 2, applying Part lll of *PPS,* 2005.
[35] *2220243 ONT Inc., Re*, [2015] OMBD No 418, at para 41, in TLCA Book of Authorities, Tab 4.
[36] http://www.mah.gov.on.ca/AssetFactory.aspx?did=10463.

The *EPA* is to be given a broad and liberal meaning.[37] The *EPA's* definition of *contaminant* means any ***solid***, ***liquid, gas, odour, heat, sound, vibration, radiation*** or combination of any of them resulting directly or indirectly from human activities that cause or may cause an *adverse effect*. ***Flyrock*** is a "solid" and one of a number of potential contaminants associated with quarry blasting.[38]

Any development must also adhere to the **D-1 Land Use and Compatibility** guideline of the Ontario Ministry of the Environment, Conservation and Parks (MOECC).[39] *Section 14(1) of the Environmental Protection Act* is the primary legislative basis for this *guideline*.

> ***Synopsis***
>
> *This guideline identifies the direct interest of the Ministry in recommending separation distances and other control measures for land use planning proposals to prevent or minimize adverse effects from the encroachment of incompatible land uses where a facility either exists or is proposed. This guideline sets the context for all existing and new guidelines relating to land use compatibility.*
>
> ***The guideline is intended to apply only when a change in land use is proposed, however, compatibility concerns should be recognized and addressed at the earliest possible stage of the land use planning process for which each particular agency has jurisdiction. The intent is to achieve protection from off-site adverse effects, supplementing legislated controls.*** [emphasis added]
>
> *The guideline encourages informed decision-making for Ministry staff, land use planning and approval authorities, and consultants.* ***All land use planning and resource management agencies within the Province shall have regard for the implications of their actions respecting the creation of new, or the aggravation of existing, land use compatibility problems.*** [emphasis added] *The Ministry shall not be held liable for municipal planning decisions that disregard Ministry policies and guidelines. When there is a contravention of Ministry legislation, Ministry staff shall enforce compliance.*
>
> ***Nothing in this guideline is intended to alter or modify the definition of 'adverse effect' in the Environmental Protection Act.*** [emphasis added]

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[37] "The *EPA* is Ontario's principal environmental protection statute. Its status as remedial legislation entitles it to a generous interpretation (*Legislation Act, 2006*, S.O. 2006, c. 21, Sch. F, s. 64; *Ontario v. Canadian Pacific Ltd.*, 1995 CanLII 112 (SCC), [1995] 2 S.C.R. 1031, at para. 84). Moreover, as this Court recognized in *Canadian Pacific*, environmental protection is a complex subject matter — the environment itself and the wide range of activities which might harm it are not easily conducive to precise codification (para. 43). As a result, environmental legislation embraces an expansive approach to ensure that it can adequately respond 'to a wide variety of environmentally harmful scenarios, including ones which might not have been foreseen by the drafters of the legislation' (para. 43). Because the legislature is pursuing the objective of environmental protection, its intended reach is wide and deep (para. 84)," *Castonguay Blasting Ltd. v. Ontario (Environment)*, [2013] 3 SCR 323, 2013 SCC 52 (CanLII), <http://canlii.ca/t/g1038>, retrieved on 2019-09-29.

[38] In *R. v. Glen Leven Properties Ltd.*, (1977), 15 O.R. (2d) 501, O.J. No. 286, the Divisional Court found that sand which naturally blows in the wind is not a contaminant, but when sand that would normally remain stationary is moved by human activity, such as a blasting operation, it becomes a contaminant. http://www.beament.com/wp-content/uploads/2016/03/2.-Ontario-Court-of-Appeal-to-Hear-Case-Involving-Flyrock.pdf.

[39] https://www.ontario.ca/page/d-1-land-use-and-compatibility#section-0.

***Irreconcilable Incompatibilities (3.4)***

***When impacts from discharges and other compatibility problems cannot be reasonably mitigated or prevented to the level of a trivial impact (defined in Procedure D-1-3, "Land use Compatibility: Definitions") new development, whether it be a facility or a sensitive land use, shall not be permitted.***[40] [emphasis added]

In *Hoffman Mining Co. Inc. v. Zoning Hearing Bd.*,[41] Hoffman leases a 182.1-acre tract in Adams Township, Pennsylvania. On November 20, 2006, Hoffman submitted an application to the Zoning Board requesting a variance from Adams Township Zoning Ordinance to allow surface coal mining within 300 feet of residences. To conduct surface coal mining, the Zoning Ordinance requires a 1,000-foot (304.8 metres) setback from residential structures. However, under the Surface Mining Conservation and Reclamation Act (SMCRA) only a 300-foot setback is required.

The SMCRA is concerned with the methods by which the mineral (coal) is derived from the surface of the ground at all stages, whereas, the Zoning Ordinance merely contains a required minimum distance from which surface mining may be conducted next to a residential structure.

***The challenged provision [setback] of the Zoning Ordinance is a quintessential land use control logically connected to land use planning and is therefore, not preempted by Section 17.1 of SMCRA.*** [emphasis added]

Hoffman's request for a variance from the township's 1,000-foot setback requirement was rejected by the Court as the setback requirement was not found to be unique to Hoffman's 182.1-acre parcel of leased land, nor was the property owner (Lessee) deprived of all economic use of the land.

*To make out a case for a validity variance, a property owner must show that "(1) the effect of the regulations complained of is unique to the applicant's property and not merely a difficulty common to other lands in the neighborhood; and (2) the regulation is confiscatory in that it deprives the owner of the use of the property."Shohola Falls Trails End Property Owners Association, Inc. v. Zoning Hearing Board of Shohola Twp., Pike County, Pa., 679 A.2d 1335, 1341-42 (Pa.Cmwlth. 1996). In that case, an owner who was claiming that the zoning deprived him of the use of the property had to show not only that the coal could not be mined, but that the property could not be reasonably used for any other purpose. Machipongo Land and Coal Co., Inc. v. Commonwealth, 569 Pa. 3, 799 A.2d 751 (2002).*

Hoffman would have been entitled to a variance from the township's 1,000-foot setback requirement from Village residences only if the 182.1-acre parcel were left with no economic use and if the proposed mining activity would not harm the health, welfare and safety of the community:

*If Hoffman had made out that the Property was so burdened that it had no economic use except to be mined for coal, it would have been entitled to a variance absent a showing that allowing it to mine within 1,000 feet would harm the health, welfare and safety of the community….Hoffman did not present any evidence showing that the Property could not be used or had no value whatsoever if it could not be mined for coal. Moreover, the Board found "that there are substantial health, safety*

[40] '"More details for specific facilities may be identified in other Ministry guidelines listed in Procedure D-1-2, "Land Use Compatibility: Specific Applications"'.

[41] *Hoffman Mining Co. v. Zoning Hearing Bd. Of Adams Twp.*, 32 A.3d 587 (Pa. 2011),

> *and welfare issue which would weigh against a reduction of the 1,000 foot setback granting the variance" because the proposed mine is located on a steep incline above the residences allowing for debris and dust to enter the village, would include open holding ponds 12-14 feet deep adjacent to where children play, and that many of the residents have significant health problems, including asthma and other breathing problems. These findings were supported by the extensive testimony of the residents before the Board. Accordingly, the Board properly denied the validity variance.*

The Court was unsympathetic to Hoffman's argument that the 1,000-foot (304.8 metres) setback from Village residences imposed by the township would deprive Hoffman of its ability to mine 88% of 220,000 tons of mineable coal, reducing potential profits by some $6,000,000.

> *Hoffman asserts that because of the unique physical circumstances and conditions of the Property, the 1,000 foot setback would deprive it of its ability to mine 220,000 tons of mineable coal or 88% of the reserves on the Property. Because the setback would have that effect, Hoffman argues that it has shown that the Zoning Ordinance has denied it of the use of its property entitling it to a variance [para. 612].*
>
> *testimony before the Board established that approximately 220,000 tons of coal with a market value of $30 per ton would be lost if the 1,000 foot setback was applied, amounting to an economic detriment of at least $6,000,000 [para. 613].*

The health, safety and welfare of the nearby Village residents was found to take priority over the mining company's desire to maximize profits by attempting to impose costly and adverse impacts on innocent third-party homeowners, and to disrupt the homeowners' quality of life.

In *Miller & Son Paving, Inc. v. Wrightstown Township*,[42] *Miller* challenged the Township's 1971 Zoning Ordinance, which as a consequence of the following setback requirements imposed on quarries reduced potential profits:

> ***Setback**. No extraction shall be conducted closer than two hundred (200) feet to the boundary of any district in which extraction is permitted nor closer than three hundred (300) feet from the center line of any street, nor closer than four hundred (400) feet to the point of intersection of center lines of two streets.*

*Miller* is the owner of a 47-acre tract, which has been used for quarrying since 1959, and operating within the previously established setback requirements of the Township, and at one point operating within 113 feet of an adjoining property, in non-conformance with the setback requirements of the new Township Zoning Ordinance. The new Zoning Ordinance extending the setback requirements for quarries was adopted by the Township on December 31, 1971.

*Miller's* challenge to the validity of the setback requirements imposed on quarries under the new Township's Zoning Ordinance was rejected, with the Supreme Court finding that,

> ***If a municipality can create a use zone excluding surface mining altogether, then it must surely be able to impose the lesser burden of requiring setbacks for such use in zones in which it is permitted [para. 610]***. [emphasis added]

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[42] *Miller & Son Paving, Inc. v. Wrightstown Township,* 499 Pa. 80 (1982), 451 A.2d 1002, https://scholar.google.ca/scholar_case?case=17369936114114070190&q=%E2%80%9Cquarry+setback%E2%80%9D&hl=en&as_sdt=2006.

*Miller's* claim that the setbacks imposed by the Township's Zoning Ordinance had deprived access to 2,685,000 tons of mineable stone worth $7,000,000 was found to be without merit:

> *Appellant…argues the local setback requirements are arbitrary, capricious and confiscatory because there are two million six hundred and eighty-five thousand tons of stone which could have otherwise been quarried to the setback restrictions established by the Surface Mining and Reclamation Act. It thus argues the application of the township's setback lines to the business of quarrying "takes" the quarry property within those more expansive lines and so cannot be justified under the police power.*
>
> ***The difficulty with this argument is it proves too much. Were we to accept it, neither zoning ordinances nor state statutes could provide setback lines for minerals suited to extraction solely by surface mining methods, since setbacks so applied would preclude extraction and thus constitute a taking of the mineral involving eminent domain, and hence not supported under the police power.***
>
> *All zoning involves a "taking" in the sense that the owner is not completely free to use his property as he chooses, but such a taking does not entitle the owner to relief, unless the owner's rights have been unreasonably restricted. See Village of Euclid v. Ambler Realty Company, 272 U.S. 365, 47 S.Ct. 114, 71 L.Ed. 303 (1926); Marple Township Appeal, 430 Pa. 113, 243 A.2d 357 (1968). Reasonable restrictions are valid exercises of the police power and not unconstitutional takings under the power of eminent domain. Restrictions are not per se unreasonable simply because they limit the extraction of minerals. The fallacy of appellant's argument is clear. If a municipality can create a use zone excluding surface mining altogether, then it must surely be able to impose the lesser burden of requiring setbacks for such use in zones in which it is permitted.*
>
> ***The valid exercise of the zoning power is predicated upon its exercise for a legitimate public purpose. Accordingly, zoning ordinances must be enacted for the health, safety or general welfare of the community and their provisions, including setbacks, must advance those purposes*** [citations omitted] *In applying this test to the review of zoning ordinances this court has in some cases held that an appellant must prove the challenged ordinance bears no substantial relationship to the health, safety, morals or general welfare of the community.* [citations omitted] *Alternatively, this Court has subjected other zoning ordinances to a somewhat less stringent standard of scrutiny holding that before a court may declare a zoning ordinance unconstitutional, the challenging party must clearly establish the provisions are arbitrary and unreasonable and have no relation to the public health, safety, morals and general welfare.* [citation omitted] *Regardless of which standard of scrutiny we employ the zoning ordinance is normally presumed valid and the burden of proving otherwise is on the challenging party. See Schubach v. Silver, supra; National Land, supra.*[6] [emphasis added]

The Supreme Court also ruled that a property owner "does not have a vested right under the doctrine of natural expansion to extend a non-conforming setback beyond that which existed at the time the new [zoning] ordinance was passed."

## *BLASTING IS AN ULTRAHAZARADOUS ACTIVITY SUBJECT TO STRICT LIABILITY*

In *V & G Inc. v. Piedmont Drilling & Blasting*,[43] the plaintiff successfully argued, and the defendant conceded, that blasting is subject to strict liability as no amount of due care can predict with certainty the consequences of the use of explosives. As noted by the appeals court, the courts have consistently held that blasting with explosives is an ultrahazardous activity for which strict liability is imposed:

> *Plaintiff correctly asserts that blasting with explosives is deemed an "ultra hazardous" activity, for which strict liability is imposed. Guilford Realty & Insurance Co. v. Blythe Brothers Co., 260 N.C. 69, 131 S.E.2d 900 (1963). In Blythe, plaintiffs sought compensation for damages caused by defendant's use of explosives to blast a tunnel for a sewer line. The Court held:*
>
> > **Blasting is considered intrinsically dangerous; it is an ultrahazardous activity ... since it requires the use of high explosives and since it is impossible to predict with certainty the extent or severity of its consequences.... "Blasting operations are dangerous and must pay their own way.... The principle of strict or absolute liability for extrahazardous activity thus is the only sound rationalization."** [emphasis added]
>
> *19 Id. at 74, 131 S.E.2d at 904 (quoting Wallace v. A.H. Guion & Company (S.C.), 237 S.C. 349, 354, 117 S.E.2d 359, 361 (1960)) (citations omitted). North Carolina cases decided after Blythe have uniformly held that blasting is an ultra hazardous activity for which the actor is strictly liable. See, e.g., Kinsey v. Spann, 139 N.C.App. 370, 374, 533 S.E.2d 487, 491 (2000), in which this* Court reiterated that:
>
> > **Ultrahazardous activities are those that are so dangerous that even the exercise of reasonable care cannot eliminate the risk of serious harm. In such cases, the employer is strictly liable for any harm that proximately results. In other words, he is liable even if due care was exercised in the performance of the activity. In North Carolina, only blasting operations are considered ultrahazardous. (citing Woodson v. Rowland, 329 N.C. 330, 350-51, 407 S.E.2d 222, 234 (1991)) (internal quotation marks omitted).** [emphasis added]

As of 2017, there are 42 states that recognize strict liability for blasting.[44]

## *Family Forced to Abandon Home*

### *Concussion and Vibration from On-going Quarry Blasting Destroys Property & Causes Emotional Distress*

> *Explosions at a rock quarry were so strong it forced a couple to move and destroyed their house, the family claims in court. Robb and Virginia Lewis sued Papich Construction Co. in Tulare County Superior Court on Aug. 3[, 2015].*
>
> *The Lewises bought a home [single family dwelling] surrounded by 10 acres [9.54 acres] of orange orchards outside Orosi in 2000. Orosi, pop. 8,770, is in Tulare County, north of Visali and southeast of Fresno.*
>
> *[The one-storey house was built in 1960, and consists of 1,182 square feet, and is situated on a rectangular (628' x 661') lot at the southwest corner of Avenue 420 and Road 144, an unsignalized intersection.]*

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[43] *V & G, Inc. v. Piedmont Drilling & Blasting*, 644 S.E.2d 16 (2007), https://scholar.google.com/scholar_case?case=4971878775139737741&q=ultrahazardous&hl=en&scisbd=2&as_sdt=2006.

[44] Randy Gardner, "Blasting Law and Case Studies," Power Point Presentation," Vibra-Tech, 2017, https://www.vtca.org/wp-content/uploads/2017/04/Presentation_sc17_gardner.pdf.

*Five years after the Lewises moved in, the Sierra Pacific Materials rock quarry, which is 300 to 500 feet from the southwest [sic] [northeast] corner of their property, "began excavation operations."*

*Blasting at the quarry started "violently shaking" their home in September 2013. In October they noticed cracks in the drywall, in the concrete around their home, and in their water well. "Due to the violent shaking and further damage to the property that resulted from each blast from the quarry, the Lewises began suffering emotional distress associated with the significant and obvious damage to their residence and its surroundings," the complaint states.*

*That December [2013], the Lewises were so terrified the blasts were compromising the structural integrity of their home they moved out. The blasting continued through at least June this year [2015], according to the complaint.*

*The blasting destroyed their house, "with the structure no longer on its foundation and with the walls no longer vertical and plumb," the Lewises say. The stress from losing their home caused both of them to seek medical treatment, the couple says.*

*They say Papich should have known that "setting off large explosive devices" near the house could cause "concussive shock waves to enter (their) Property" and destroy it.*

*The Lewises seek declaratory judgment that Papich is liable for their losses and at least $25,000 in damages for strict liability, tort for ultrahazardous activity, trespass and nuisance.*[45]

The law suit against the owner of the quarry was settled in October 2017, prior to the scheduled trial date. It is unknown whether the homeowners were required to sign a non-disclosure agreement as part of the settlement.

## *DANGERS & NUISANCES ASSOCIATED WITH QUARRIES*

Similar concerns over the dangers of *blasting* and the hazards of *flyrock* have been expressed by the Federal Mine Safety and Health Review Commission (FMSHRC):

***…[A]lthough all mine safety standards are important, the subject of blasting, an inherently dangerous activity, and the hazards of flyrock are particularly noteworthy and have been the subject of several cases and safety studies. Several litigated cases underscore the gravity associated with that activity and the importance that proper procedures be employed***. [emphasis added]

*For example, in Revelation Energy, 36 FMSHRC 1581, 1587, 1600 (June 2014) (Judge Andrews), a violation of § 77.1000 was found to be significant and substantial where flyrock fell in an inhabited area approximately 1000 feet [305 metres] from a blast site. It was determined that the respondent failed to strictly follow their Ground Control Plan, as required. Id. at 1603. Similarly, in Central Appalachia Mining, LLC, 29 FMSHRC 430, 430-31 (June 2007) (Judge Barbour), flyrock from a highwall blast flew into the pit where miners were working. Vehicles were hit, and a miner suffered a compound fracture when his leg was hit. Id. at 433. The judge found that the violation of 30 C.F.R. § 77.1000 was S&S. Id. at 444. In Lakeview Rock Products, 34 FMSHRC 244, 246 (Jan. 2011) (Judge Moran), flyrock penetrated the roof of a home located above the highwall and 600-700 yards [549-640 metres] away from the detonation site.*

*Beyond case examples, MSHA has issued blasting alerts addressing these issues. See, e.g., Blasting Safety Alert: 6 Fatalities from blasting accidents 2010-2013, http://www.msha.gov/Alerts/SAbulletins/BlastingAlert12014.pdf. Studies also warn of these hazards. See T. S. Bajpayee et al., Blasting Injuries in Surface Mining with Emphasis on Flyrock*

[45] Rebeka Kearn, "Quarry Blasting Shakes California Home Apart," Courthouse News Service, August 10, 2015, https://www.courthousenews.com/quarry-blasting-shakes-california-home-apart/ (Case Number VCU261929, *Lewis, Robb vs. Papich Construction Co., Inc.*, 08/03/2015)

> *and Blast Area Security, 35 J. Safety Res. 47 (2004). These resources note that serious injuries and fatalities result from improper practice during rock blasting [p. 5]*[46]

As blasting is the most dangerous aspect of operating a quarry, a generous *setback* is essential to protect workers and the general public. When establishing setbacks from populated areas or human activity, the setbacks should reflect a worst case scenario, and allow for human error (overloading with explosive and mistakes in blast design[47]) and the unpredictability of flyrock. According to expert testimony presented during the Ministry of Environment's (MOE) investigation of two flyrock incidents in July 2009 at Pakenham Quarry, near Arnprior,[48]

> ***Any experienced blaster would have had the same fly rock incident take place." "There is no technology to identify anomalies in rock such as mud seams or voids." "90% of all fly rock incidents are unexplainable." "[The expert] advised 'that the hazard zone [for Pakenham Quarry] be increased to 500 m when firing any future blasts****…'* [emphasis added]

## *Flyrock - No Amount is Acceptable – the Need for Adequate Setbacks*

Concerns expressed over the danger of *Flyrock* are posted on New England Laborers' Health and Safety Fund's website:[49]

> ***Blasting can be much more dangerous than you think. Even if you are thousands of feet away from the blast, you can still be hit by debris from the blast. This debris is called Flyrock.*** *Flyrock can travel at high speeds and very far from the blast area. It can easily pierce a windshield or even the metal of a truck.* [emphasis added]
>
> *Here is an example of an incident that occurred in West Virginia.* ***A worker thought he was safely seated in the cab of his truck about 2000 feet [610 metres] from the blast, when all of a sudden he saw flying rocks propelling toward him. Luckily, he was able to duck below the dashboard and was not injured. A rock, the size of a football entered the front of the windshield, traveled where his head would have been and exited the back. Other rocks in the cloud dented the truck. If any of the flying rocks would have hit the driver, he could have been killed. The furthest rocks from the blast flew about 6000 feet [1,829 metres]****.*[emphasis added]
>
> *Laborers can be exposed to the dangers of Flyrock while working in/on or around a blasting operation. Flyrock can affect both construction workers and bystanders. Flyrock is one of the major causes of blasting-related injuries.*
>
> *Flyrock can result in critical injuries or even fatalities. Flyrock is also a frequent cause of damage to equipment and facilities.*

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[46] https://www.fmshrc.gov/decisions/alj/ALJo_8032015-KENT%202012-979%20Kentucky%20Fuel%20Corporation.pdf.

[47] *"Working to Protect Your Community and Environment," http://sg.crcrockwood.org/wp-content/uploads/2019/03/Doug-Tripp-Flyrock-backgrounder-CRC-Popular-Science.pdf.*

[48] Quoting from http://sg.crcrockwood.org/wp-content/uploads/2019/03/Flyrock-FAQ-True-and-False.pdf.

[49] http://www.nelhsf.com/nelhsf-library/safety/flyrock/.

On January 23, 2018, in response to a number of serious injuries suffered by miners as a result of premature blast, the Mine Safety and Health Administration (MSHA) issued a safety alert[50] addressing the dangers of flyrock:

> ***MSHA recommends that Blast Area should as a minimum be one and a half times the furthest distance that any previous fly rock has travelled.*** [emphasis added]
>
> ***Blasting is a serious and potentially dangerous practice on a mine site due to the use of explosives, and it is difficult to determine the specific trajectory of fly rock during a blast***. [emphasis added]

Previously, on March 24, 2016, the MSHA expressed the following concerns about flyrock:[51]

> *Flyrock – the fragments of rock thrown and scattered during blasting – is responsible for a large proportion of all blasting-related injuries and fatalities. Flyrock is a potential hazard anytime and anywhere there is blasting.*

According to *Eloranta*, who was responsible for revising the International Society of Explosives Engineers (ISEE) Handbook chapter on open pit and quarry operations, it is unethical to disregard public safety and to accept flyrock as inevitable:

> ***[A]nyone involved in blasting is obligated to place safety above all other considerations, according to Eloranta. Even if blasts that launch life-threatening rocks into populated areas are rare, even if no one is injured, accepting that as inevitable is unethical***.[52] [emphasis added]

A blaster-training module[53] funded by the Office of Technology Transfer, Western Regional Office, Office of Surface Mining, U.S. Department of the Interior points out the potential for severe adverse impacts from flyrock:

> *[Flyrock is] The Single Factor Of Surface Mining That is Most Likely to Cause A Fatality!!! [p. 57]*
>
> *Flyrock is the single most dangerous adverse effect that can cause property damage and personal injury or death [p.4]. Flyrock is the number two killer in mining operations [p.60].*

A September 28, 2006 memo from the Department of Mines, Minerals and Energy of the Commonwealth of Virginia[54] to "All Licensed Mine Operators and Blasting Contractors," expresses alarm and grave concern over a number of flyrock incidents experienced in the recent past:

> ***The mineral mine community in Virginia has experienced a number of flyrock incidents in the recent past. More specifically, there have been 5 reported incidents since December 2003; 4 of them have occurred since March 2005.***

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[50] Justin Winter and Jackson Lewis, "MSHA Issues Warning On Blast Safety Following Fly Rock Injuries," January 23, 2018. https://www.jdsupra.com/legalnews/msha-issues-warning-on-blast-safety-39564/.

[51] "Flyrock Dangers & Best Practices," https://www.msha.gov/news-media/announcements/2016/03/24/flyrock-dangers-best-practices.

[52] https://www.mankatofreepress.com/news/local_news/expert-flyrock-from-any-blast-unacceptable/article_8ad31cf8-b5cf-11e7-bf58-c3cdd328cf7f.html.

[53] https://www.osmre.gov/resources/blasting/docs/WYBlasterCertModules/8AdverseEffectsBlasting.pdf.

[54] "Flyrock Prevention" Memorandum issued September 28, 2006, https://www.dmme.virginia.gov/DMM/PDF/SAFETY/ALERTS/blastingflyrock/FlyrockMemo.pdf

> ***This is a matter of grave concern to the Division. All of these incidents had the potential to cause death or serious personal injury to citizens.***
>
> ***The occurrence of flyrock can be considered an "imminent danger", and result in the issuance of a Closure Order to the operator.***
>
> ***"Imminent Danger" – means the existence of any condition or practice in a mine which can be expected to cause death or serious personal injury before such condition or practice can be abated.*** [emphasis and underscoring added]

As reported in the June 2013 issue of the *NRIAG Journal of Astrophysics and Geophysics*,[55] the damage caused by flyrock is both undesirable and self-evident:

> ***Fly rocks are considered to be the most undesirable movement of rocks during the blasting activities. Damage by a fly rock can not be refuted; the evidence is usually present and visible [p. 103].*** [emphasis added]

As reported in the 2014 issue of the *Journal of Rock Mechanics and Geotechnical Engineering*,[56] flyrock is an inevitable consequence of quarry blasting and can never be entirely eliminated:

> ***Due to the explosive force, rock fragments are propelled and thrust high into the air and beyond the safety limit of blast area, thus termed as "flyrock". This is mainly due to the flaws presented in the blast design and also due to the misinterpretation of rock mass behavior. The phenomena of flyrock are always uncontrolled and can never be brought down to zero [p. 447]***. [emphasis added]

In the United Kingdom, over a five-year period, where incidents of flyrock had been reported and documented, cumulatively 100% of the flyrock incidents occurred within 800 metres of the blast site, as summarized by *Hill*.[57]

| Distance from blast (m) | Number of incidents | Percent of total | Cumulative % |
|---|---|---|---|
| 100 | 17 | 20 | 20 |
| 200 | 22 | 26 | 46 |
| 300 | 25 | 29 | 75 |
| 400 | 7 | 8 | 84 |
| 500 | 8 | 9 | 93 |
| 600 | 2 | 2 | 95 |
| 700 | 3 | 4 | 99 |
| 800 | 1 | 1 | 100 |
| **total** | **85** | **100%** | |

[55] Adel M.E. Mohamed and Abuo El-Ela A. Mohamed, "Quarry blasts assessment and their environmental impacts on the nearby oil pipelines, southeast of Helwan City, Egypt," *NRIAG Journal of Astronomy and Geophysics* (Volume 2, Issue 1, June 2013): 102-115. https://www.sciencedirect.com/science/article/pii/S2090997713000308.

[56] R. Trivedi, T.N. Singh, and A.K. Raina, "Prediction of blast-induced flyrock in Indiam limestone mines using neural networks," *Journal of Rock Mechanics and Geotechnical Engineering* © 2014, Institute of Rock and Soil Mechanics, Chinese Academy of Sciences (2014): 447-454. https://www.researchgate.net/profile/Avtar_Raina/publication/264560232_Prediction_of_blast-induced_flyrock_in_Indian_limestone_mines_using_neural_networks/links/5539cf9e0cf247b8588148a8/Prediction-of-blast-induced-flyrock-in-Indian-limestone-mines-using-neural-networks.pdf?origin=publication_detail.

[57] William Hill, "Dangers Proposed To Highway 7 By Hidden Quarry Flyrock," p.7, William Hill Mining Consultants Ltd, 2013, http://sg.crcrockwood.org/wp-content/uploads/2017/01/HQ-Flyrock-Dangers-ref.-Highway-7.pdf.

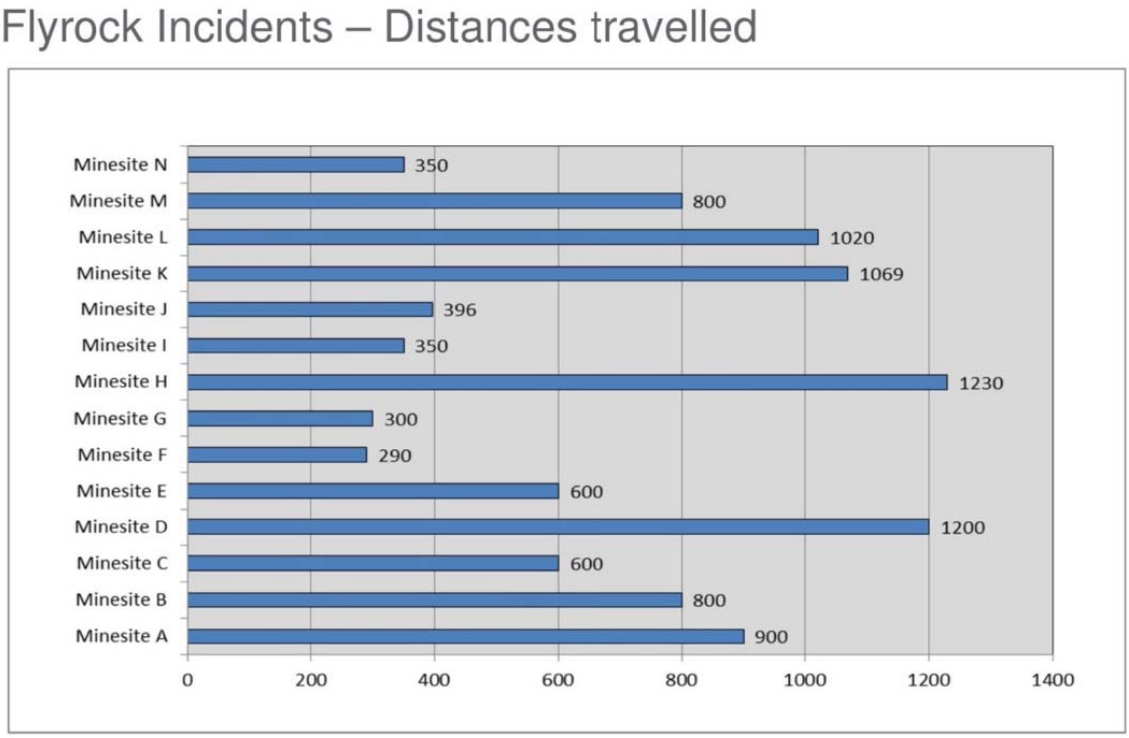
As reported in an August 5, 2013 news release issued by the publication "Quarry,"[58] in response to a 2011 flyrock incident at Brayford Quarry, the UK *Health and Safety Executive* (HSE) said that,

> ***With 3,250 injuries, including 27 fatalities, since 2000, quarrying in the UK remained one of the most dangerous industries to work in.*** **[emphasis added]**

A previous study of flyrock undertaken by HSE between 1981 and 1988, found that 17% of **reported** (known) flyrock incidents could not be explained:

> ***Although blast design is the primary protection against flyrock, only 83% of the 154 incidents investigated by the UK Health & Safety Executive (HSE) between 1981 and 1988 could have been prevented by blast design (HSE, 1989). This leaves some 17% that arose from unpredictable causes [p. 182]***[59] [emphasis added]

The Explosives Expectorate of the Queensland Government included the following graph of flyrock incidents in a 2015 presentation:[60]




- The 14 documented incidents of flyrock indicate a propelled distance of 290 metres to 1,230 metres.
- The average distance of the 14 flyrock incidents is 708 metres.

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[58] https://www.quarrymagazine.com/Article/3260/Quarry-blast-goes-drastically-wrong.
[59] Study on Methods and Supervision of Rock Breaking Operations and Provision of Temporary Protective Barriers and Associated Measures GEO PEPORT No. 260, August 2002, Halcrow China Limited https://www.cedd.gov.hk/filemanager/eng/content_475/er260links.pdf.
[60] https://www.dnrm.qld.gov.au/?a=298324.

- The distribution of flyrock incidents includes 5 between 290 and 396 metres, 5 between 600 and 900 metres, and 4 between 1,020 and 1,230 metres.

A subsequent report for the year of October 2016 to September 2017, issued by Department of Natural Resources for the State of Queensland reported 8 flyrock incidents.[61]

The Queensland Explosives Inspectorate is a division within the Department of Natural Resources, Mines and Energy of the Queensland Government that works closely with the explosives and fireworks industries and the community to ensure the safety of people working in these industries and the general public.

> ***There have been a number or recent instances of flyrock resulting from blasting activities in the construction industry. The incidents were all high potential incidents that could have resulted in death or injury. Property damage and traumatization of members of the public have occurred.***[62] [emphasis added]

The dangers of flyrock are highlighted in the Worker's Hazard Alert issued by the National Institute for Occupational Safety and Health (NIOSH):[63]

> ***Flyrock has killed and injured people. Flyrock material, both within the blast area and outside it, is responsible for over half of all blasting-related injuries and fatalities. MSHA (Mine Safety and Health Administration) records from 1994-2001 show that in surface mining, 32 people were killed or badly hurt because the blast area was not cleared. Another 17 people were injured or killed by rocks that were thrown outside of the blast area. This total (49 People) is greater than the combined total of the other blast accident causes in mining (premature blast, transporting explosives, fumes, and misfires). Flyrock is a potential hazard anytime and anywhere there is blasting.*** [emphasis added]

Quarry operations in Malaysia are branded as *heavy industry*, requiring a minimum buffer zone of 500 metres from the intended blasting area to the nearest residential or industrial area (Environmental Requirements: A Guide to Investors 2010, Appendix G). Even this setback requirement proved inadequate when a tragic blast on July 19, 2013 at Masai quarry propelled flyrock up to 700 metres away, with devastating consequences:

> ***The massive explosion caused rocks and boulders to rain down on the nearest industrial park…which is 700 metres from the site….[A] factory worker was killed, 10 people were injured, 18 cars and 14 factories were damaged [p. 1584]***.[64] [emphasis added]

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[61] https://www.dnrme.qld.gov.au/__data/assets/pdf_file/0005/1406984/incidents-complaints-report-2017.pdf

[62] https://www.dnrme.qld.gov.au/business/mining/safety-and-health/alerts-and-bulletins/explosives/flyrock-incidents

[63] http://www.cfins.com/wp-content/uploads/2019/01/blasting-safety-worker-alert.pdf.

[64] Karthigeyan A/L AL. Ramanathan and Rini Asnida Abdullah, "Effects of Quarry Blasting Towards the Residential Area at Kangkar Pulai, Johor, Malaysia," http://www.ukm.my/jsm/pdf_files/SM-PDF-48-8-2019/03%20Karthigeyan%20a_l%20AL.%20Ramanathan.pdf.

A brochure[65] produced by the mining and quarrying companies of Nova Scotia as an effort to assure the public that blasting does not have an adverse effect on neighbouring properties alludes to the fact that,

> *[All] regulated blasting buffers in Nova Scotia are 800 metres, [making] the risk to groundwater or anything else…extremely low.*

According to *Blanchier*,[66] the risk and adverse effects of flyrock associated with quarry blasting is seldom or properly addressed as part of the investigations and studies undertaken in support of an application for a licence to permit quarry operations, even though flyrock is considered a greater hazard than vibrations or airblast:

> ***Accidental flyrock in blasting operations has a major impact on the external environment…due to the hazards involved and is more significant than vibrations or airblast….[E]ven if it is normal practice in these zones to take into account the impact of possible vibrations and even the effects of airblast when modeling the project, flyrock risks are not dealt with in initial studies, other than by way of integrating general safety distances. These risks are only sometimes taken into account much later in the operation and most often, following an accident or significant flyrock being recorded externally [off-site] [p. 549].*** [emphasis added]

According to *Bhandari* and *Jain*,[67] there is considerable variability in the distance that flyrock can travel, and even the best designed blast can generate flyrock. In 1982, The Director General of Mines Safety India recommended setbacks be increased from 300 metres to 500 metres:

> ***Flyrock can still be generated even in the best-designed blast. Flyrock distances can range from zero for a well[-]controlled mine blast to nearly 1.5 km for a poorly confined large, hard rock mine blast and many fatalities have occurred****. In a circular, The Director General of Mines Safety India in 1982 had recommended that personnel be removed up to 500 m, though previous limit was 300m only. Thus, where large diameter blasting is carried in hard rock mining, extra precautions are required to control the flyrock damages in the surroundings [p. 6].* [emphasis added]

According to *Raina et al*,[68] the research on flyrock is "abysmal," due to under- or non-reporting of flyrock incidents and to the high costs of experimentation, and flyrock arising from open pit blasting continues to confound rock excavation engineers:

> *Flyrock, arising from open-pit blasting, still eludes rock excavation engineers, despite a reasonable understanding of throw [p. 660].*[69]

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[65] "Not Your Grandfather's Mining Industry," https://notyourgrandfathersmining.ca/faq.

[66] A. Blanchier, "Quantification of the levels of risk of flyrock," Rock Fragmentation by Blasting: The 10th International Symposium on Rock Fragmentation by Blasting, 2012 (Fragblast 10); Leiden: 549-553.

[67] Sushil Bhandari and Sheetal Jain, "Managing And Environmental Issues Due to Blasting Operations," *Earth Resource Technology* http://earthresourcetechnology.com/downloads.aspx.

[68] Avtar K. Raina, V.M.S.R. Murthy and Abhay K. Soni, "Flyrock in surface mine blasting: understanding the basics to develop a predictive regime," *Current Science* (Vol. 108, No. 4, 25 February 2015): 660-665.

[69] Hustrulid, W., "Blasting Principles for Open Pit Mining," Vol. 1, General Design Concepts, A.A. Balkema, Rotterdam, 1999, pp. 285–289; Chernigovskii, A. A., "Application of Directional Blasting in Mining and Civil Engineering," Oxidian Press India Private Ltd., New Delhi, 1985, pp. 91–112; and Carter, C. L., "A proposed standard for the objective measurement of muck pile profiles." In Third International Symposium on Rock Fragmentation by Blasting, ISEE, Brisbane, 1990, pp. 59–162.

> *Despite the fact that flyrock consumes only 1% of the explosive energy used in a blast,[70] it is more serious in nature, in comparison to ground vibrations, as it can inflict damages, injuries and fatalities. Several authors have reported that 20–40% of the blasting related accidents are due to flyrock.[71] The research on flyrock is, however, abysmal[72] and considering the above-mentioned facts, the problem deserves more attention from the researchers.*
>
> *Hence, it is essential to identify the reasons for lack of R&D on flyrock. Under or non-reporting of flyrock[73] probably due to heavy penalties imposed by regulatory agencies, high cost of experimentation, and the random nature of flyrock are some of the reasons identified for inadequate R&D on flyrock. Such limitations are the cause for low confidence with regard to the existing predictive models of flyrock distance.*
>
> ***One of the downers in flyrock prediction is its random nature, as one cannot generate a flyrock and need to rely on chance…Since flyrock is a potential threat to property and life, one cannot risk under-prediction [p. 661].*** [emphasis added]

A failure to report or under-report flyrock incidents are major environmental and safety concerns shared by the European Federation of Explosives Engineers (EFEE), as expressed in its December 2016 Newsletter:[74]

> ***The work of the EFEE's Environment Committee has shown in the last few months that it is still very difficult to obtain feedback about [flyrock] incidents or accidents occurring during blasting operations***.[emphasis added]
>
> *Although everyone agrees that this feedback is fundamental for preventing probable future incidents and therefore for risk management, the incidents and their causes are still badly indexed. However, civil society, elected officials and especially residents, increasingly demand that these [flyrock] incidents be accounted for by public authorities, companies, and sometimes request information directly via the press or television.*
>
> *Over and above dealing with a specific incident, preventing flyrock risk requires that this aspect of the environmental impact of blasting be explicitly integrated into blaster and blasting training, as well as into regular meetings on work safety organized in accordance with labour legislation.*

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[70] Berta, G. L.,"Esplosivo strumento di lavoro (Explosives: An Engineering Tool)," Italesplosivi, Milan, 1990, pp. 31–64.

[71] Bajpayee, T. S., Rehak, T. R., Mowrey, G. L. and Ingram, D. K., "Blasting injuries in surface mining with emphasis on flyrock and blast area security." J. Saf. Res., 2004, 35(1), 47–57; Verakis, H., "Flyrock: a continuing blast safety threat," 2011; http://docs.isee.org/ISEE/Support/Proceed/General/11GENV1/11v161g.pdf; and Mishra, A. K. and Mallick, D. K., "Analysis of blasting related accidents with emphasis on flyrock and its mitigation in surface mines." In Rock Fragmentation by Blasting (eds Singh, P. K. and Sinha, A.), Taylor and Francis, London, 2013, pp. 555–561.

[72] Raina, A. K., Soni, A. K. and Murthy, V. M. S. R., "Spatial distribution of flyrock using EDA: An insight from concrete model tests." In Rock Fragmentation by Blasting (eds Singh, P. K. and Sinha, A.), Taylor and Francis, London, 2013, pp. 563–570.

[73] Davies, P. A., "Risk based approach to setting of flyrock danger zones for blasting sites." Trans. Inst. Mines Met., May–August 1995, 96–100.

[74] EFEE Newsletter, December 2016, https://efee.eu/wp-content/uploads/2016/12/2016-12-EFEE-Newsletter-3.pdf.

Flyrock is a public safety issue, and setback requirements should not be reduced in favour of economic interests of the aggregate industry over the health, safety and welfare of the public. A mandatory setback of 800 metres from any sensitive land use (or activity) or settlement area[75] imposed on a proposed blasting quarry or existing blasting quarry expansion would eliminate many of the potential adverse impacts of flyrock. Blasting below the water table has numerous known adverse environmental impacts, warranting a greater setback, and karst terrains should be avoided.[76]

> ***Absent site specific studies, MOE's Guideline D-6 requires pits and quarries to be considered Class III Industrial Facilities and the recommended separation distance is 1,000 m [p. 38]***[77] [emphasis added] [The following Class III industrial traits are consistent with some, but not all, of the undesirable characteristics and adverse impacts of a blasting quarry operation.]
>
> ***Outputs***
> - ***Noise:*** *Sound frequently audible off property [blasting, excavation, quarry equipment and vehicles]]*
> - ***Dust and/or Odour:*** *Persistent and/or intense [blasting, excavation, quarry equipment and vehicles]*
> - ***Vibration:*** *Ground-borne vibration can frequently be perceived off property [blasting, excavating]*

> ***Scale***
> - *Outside storage of raw and finished products*
> - *Large production levels*

> ***Process***
> - *Open process*
> - *Frequent outputs of major annoyances*
> - *High probability of fugitive emissions*

> ***Operation/Intensity***
> - *Continuous movement of products and employees*
> - *Daily shift operations permitted*

According to *Eloranta*,[78] (former) vice-president for technical matters for the International Society of Explosives Engineers (ISEE), there is no practical economic way of preventing flyrock impacts from quarry blasting:

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[75] **Settlement areas:** means urban areas and rural settlement areas within municipalities (such as cities, towns, villages, and hamlets) that are built up where development is concentrated and lands which have been designated in an official plan for development over the long-term horizon provided for in policy 1.1.2. (PPS). Where land in *designated growth areas* is not available, the *settlement area* may be no larger than the area where development is concentrated (p. 48, 2014 Ontario Provincial Policy Statement).

[76] **Karst:** Terrain composed of or underlain by carbonate rocks that have been significantly altered by dissolution (i.e., the process in which a solid or liquid becomes dissolved in ground water). See "A glossary of Hydrological Terms," Department of Geological Sciences, University of Texas, 2007. http://www.geo.utexas.edu/faculty/jmsharp/sharp-glossary.pdf. See also *Southern Ontario Karst* map, Ontario Geological Survey (Brunton and Dodge, 2008), http://www.geologyontario.mndm.gov.on.ca/mndmfiles/pub/data/imaging/GRS005//karst-map.pdf.

[77] "Protecting Health: Air Quality and Land Use Compatibility," Halton Region Health Department, February 2009.

[78] *Eloranta* has 29 years of blasting experience, has degrees in mining and geology, has a master's degree in mining, has authored more than 20 papers on mining and blasting, and revised the ISEE Handbook chapter on open pit and quarry operations. In 2004, he was awarded the President's Award by the society for meritorious service to the explosives industry. In 2005, he was elected to the board of directors for the ISEE. Eloranta & Associates Inc. website: https://elorantaassoc.com/about-us/. He is also a past President of ISEE.

*"Really, flyrock is intolerable." Any amount of flyrock is unacceptable. You lose control of the process at that point," said Eloranta. "Speaking generally, Eloranta said flyrock doesn't automatically suggest an excessive amount of explosives had been used. "Explosives doesn't equal flyrock," he said."*

*Proper design of the blast is critical, ensuring that there's enough distance between the columns of explosives at the bottom of drill holes and the sheer edge of the shelf of rock. That's known as "burden," and it keeps the force of the blast from launching rocks from the shelf face. The material above where the explosives are placed, called "stemming," is equally important to keep flyrock from being ejected vertically from the blast.*

*The force of an explosion is going to seek a path of least resistance, Eloranta said. If the design is done correctly, there is no path of least resistance. The power of the blast simply does its job of pulverizing the rock and shifting it slightly away from the face of the shelf.*

*A fault in the rock, if unknown to the explosives engineer, can provide a path for that explosive energy that can mess up an otherwise well-designed blast, he said. "The same amount of energy in there can just launch those materials."*

*Caution can be costly. It's not accurate to suggest that the presence of faults and seams in a section of rock is unknowable, though. Enough geologic testing could identify those problem areas. But there's an economic issue with that solution. "The cost of the testing would exceed the value of that product," Eloranta said…*

***[A]nyone involved in blasting is obligated to place safety above all other considerations, according to Eloranta. Even if blasts that launch life-threatening rocks into populated areas are rare, even if no one is injured, accepting that as inevitable is unethical.*** [emphasis added]

***"To say 'It might happen again, there's nothing we can do about that,' well, nobody buys that," he said.*** [emphasis added]

***The options, really, are only two in Eloranta's mind: Don't blast in a location that threatens public safety or adopt the safety measures required, regardless of the price, that meet the challenges Mother Nature has put in place.***[79] [emphasis added]

## Unpredictability of Flyrock and Its Consequences

It has long been known that when planning blasts flyrock remains one of the most erratic and dangerous factors, even when predictive formulae are based on measurements of worst case scenarios:

***In the blasting industry, flyrock causes more deaths, injuries and asset damage than all other causes put together. A surprising statistic? A North American study of 412 lethal and non-lethal accidents in 2001 found that 27.7 per cent of these accidents were caused by wild flyrock outside the clearance zone and 45.6 per cent were due to localised flyrock within the clearance zone.*** [emphasis added]

*A final word of caution: these predictive formulae are based on measurements of worst case scenarios of flyrock throw.* ***Flyrock is notoriously inconsistent and a prediction of 200m does not mean that flyrock will travel 200m from every blast.*** [emphasis added]

***Worst case occurrences generally happen when a blast hole intersects a fault zone or is collared in broken rock which has been fractured during previous blasting.*** [emphasis added]

*It is easy to use an observational approach and keep on incrementally reducing the stemming. This might work for dozens of blasts, and then there will be that one rogue blast hole that proves the formulae correct.* ***It only takes one hole to create enough wild flyrock to create a possibly***

[79] Expert: Flyrock from any blast "unacceptable", The Free Press, Oct 21, 2017, https://www.mankatofreepress.com/news/local_news/expert-flyrock-from-any-blast-unacceptable/article_8ad31cf8-b5cf-11e7-bf58-c3cdd328cf7f.html.

> ***tragic situation, and at the same time risk the loss of the quarry licence, the shotfirer's licence and the company's insurance policy.***[80] [emphasis added]

Various empirical relationships have been established to predict flyrock resulting from blasting. In calculating flyrock distance, the existing empirical methods only consider a limited number of effective parameters. Other parameters such as blast geometry, geological conditions and human error also affect the measure of flyrock distance. Consequently, the empirical methods are not accurate enough in many cases, even though prediction of the exact values of flyrock distances is crucial to estimate the extent of the blast safety area.[81]

Most flyrock incidents go unnoticed or unreported, concealing the true extent of the potential adverse impacts of blasting. The percentage of documented flyrock incidents occurring due to flyrock justifies its significance irrespective of the fact that the problem is seldom reported.[82]

## Flyrock Meets Ontario EPA Definition of Contaminant

According to the Supreme Court of Canada,[83] in its interpretation of Ontario's *EPA*, the *adverse effects* of "flyrock" occasioned by blasting are not *trivial*.

> *[Castonguay] "discharged" fly-rock into the "natural environment", and there is no doubt that fly-rock meets the definition of "contaminant". The discharge was "out of the normal course of events", and it caused an "adverse effect" under the definition of that term in s.1(1), namely, it caused injury or damage to property and loss of enjoyment of the normal use of property. The adverse effects were not trivial. The force of the blast, and the rocks it produced, were so powerful they caused extensive and significant property damage, penetrating the roof of a residence and landing in the kitchen. A vehicle was also seriously damaged. The fly-rock could easily have seriously injured or killed someone.*

According to the Ontario Ministry of the Environment, Conservation and Parks (MOECC), a blasting quarry is a Class III[84] *use*. Guideline D-6 recommends a *Potential Area of Impact* of 1,000 metres and *Minimum Separation Distance* of 300 metres from the property line of a sensitive land use. A blasting quarry is the most disruptive, destructive, and polluting Class lll use, and the *adverse impacts* of blasting can extend well beyond 1,000 metres, above and below ground, especially in a karst environment.

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[80] Article by John Butchart from *Quarry* posted February 1, 2014 https://www.quarrymagazine.com/Article/3569/Flyrock-prediction-From-mystery-to-science.

[81] In a controlled study of 113 blasting operations at Putri Wangsa quarry, the most influential parameters on flyrock including hole depth, burden to spacing ratio, stemming length, maximum charge per delay, powder factor, rock density and Schmidt hammer rebound number were considered as input parameters, whereas the flyrock distances were assigned as the output parameter. Actual flyrock distances measured 43.7 meters to 205.5 meters. https://www.hindawi.com/journals/tswj/2014/643715/#B10, Table 1.

[82] Avtar K. Raina, V.M.S.R. Murthy and Abhay K. Soni, "Flyrock in surface mine blasting: understanding the basics to develop a predictive regime," *Current Science* (Vol. 108, No. 4, Feb. 2015): 660-665. https://www.currentscience.ac.in/cs/Volumes/108/04/0660.pdf.

[83] *Castonguay Blasting Ltd. v. Ontario (Environment)*, [2013] 3 SCR 323, 2013 SCC 52 (CanLII), <http://canlii.ca/t/g1038>, retrieved on 2019-09-29

[84] MOECC D-6-3 Separation Distances https://www.ontario.ca/page/d-6-3-separation-distances.

At Miller Braeside Quarry, as acknowledged during an Ontario Municipal Board (OMB) hearing, blasting caused flyrock to travel 400 metres.[85] The OMB rejected *Miller Paving's* argument that the setback for the expanded quarry should be measured from the *dwelling* rather than the *property line* of the adjacent residences in a designated Settlement Area.

> ***[T]he general rule in key Ministry guidelines is that 300 m is the recommended minimum distance from the property line. That 300 m figure is a "minimum"; indeed, even when operations were farther from neighbours than 300 m,[86] adverse impacts still precipitated two Court Orders [para. 158]. [OMB Decision October 27, 2015, as amended on December 18, 2015.]*** [emphasis added]

The adjacent properties are rural residential and each has a typical lot depth of 220 metres (722 feet). *Miller*, the quarry owner, demanded the rear 150 metres (492 feet) of each residential lot be included in the 300 metre setback as part of its plan to expand the existing quarry. By demanding that the rear 150 metres of each lot be part of the 300 metre setback from the quarry, *Miller's* contribution to the 300 metre setback amounted only to 150 metres, roughly one-half of the setback requirement. The rear 150 metres of each homeowners's lot, in which *Miller* has no possessory interest, would effectively be sterilized, precluding any development of the rear yard, vastly reducing the use and enjoyment of the rear yard as amenity space, and causing a significant reduction in the value of each homeowner's property. Conversely, *Miller* would benefit financially, enhancing profit at the expense of innocent third-party homeowners, if permitted to increase the extraction zone of the quarry by 9.7 hectares or 24.0 acres. This is akin to the *taking* of property rights without compensation. Moreover, in the event that future quarry blasting causes further flyrock incidents, the health and safety of the residents will again be endangered. A 300-metre setback or buffer zone is inadequate to avoid an adverse effect on the neighbouring residential properties, considering that past quarry blasting had propelled flyrock a distance of 400 meters into a cluster of neighbouring residential properties and caused property damage.

The OMB alluded to an earlier detailed 38-page decision of the Ontario Superior Court of Justice (Small Claims Court) issued on November 3, 2011. The neighbouring homeowners claimed that "noise and odour from the portable asphalt plant interfered with the reasonable and ordinary use of their properties." As to the severity of the harm endured by the homeowners, the trial judge had this to say:

> *Overnight the enjoyment of their land and residences was substantially interfered with. The noise during the day was described as noisy especially when wind was blowing in their direction, "like a "freight train," "a fan running beside the bed," "like being next to an airport," "a plane idling on the runway," "bad," "horrible to live beside," "louder than a diesel freightliner idling," "place became a loud industrialized neighbourhood," "like a big steam generator," "slamming of tail gates," "like sitting behind a jet engine," "was really quiet [sic] load," "very annoying," "really really bad," "a constant noise," "unbearable," "louder than television or dishwasher running in the house [para. 64]."*

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[85] *Miller Paving Ltd.,* PL130785, OMB, October 27, 2015 http://www.omb.gov.on.ca/e-decisions/pl130785-Oct-27-2015.pdf.

[86] In 2005, one neighbour described flyrock from a "mega" blast that landed on his roof, over 400 metres from the quarry site.

> *The odour and noise occurred on and off from September 28, 2009 to November 16, 2009…while the plant was located in the quarry. It was more frequent for some…than others depending on their times at home as opposed to times at work and sometimes depending on the wind direction. Nevertheless the noise and odour was there in the mornings, afternoons and during the night. To escape it they would close all doors and windows and stay in the house. This did not always totally alleviate the problem. The problem the plaintiffs had was that they never knew when to expect the noise or odour and they therefore could not plan any outdoor activities as they had done prior to the fall of 2009. The interference was enough to meet the severity of the harm test [para. 67].*

In his ruling, the trial judge also relied on a November 24, 2009 Air Facility Inspection Report, prepared by *MOE*, which states:

> *[T]he operation of "this plant at this location" may be causing an adverse effect as defined under Section 14 of the Environmental Protection Act. It also stated the odour was noted as a distinct odour at 4 residences and noise levels were clearly audible at 16 observations [para. 77].*

*Miller's* "air quality" experts' evidence was characterized by the judge as less than credible:

> *I find it impossible to accept the findings of Mr. Trought and Dr. Wiseman that plaintiffs['] symptoms are caused by vehicle exhaust, wood burning, cigarette smoke or food as opposed to the fumes from the plant [para. 81].*

Residential land uses, including associated amenity space, are considered *sensitive* 24 hours per day (D-6, p.3). Finding in favour of the neighbours on the torts of *trespass* (in the form of contaminants), *negligence* (duty of care), and *nuisance*, the court alluded to "the character of the neighbourhood," and found that it had significant "residential" traits:

> *[The area] is zoned rural and if anything it would be much more residential than commercial, as there is only a roof truss business, a quarry and farming property in the area as opposed to approximately 150 residential houses….*
>
> *The plaintiffs were aware that there was a quarry when they purchased their properties but they did not know that this asphalt plant was going to operate in it.…The noise and odour that they experienced when the plant started was severe. Overnight, the enjoyment of their land and residences was substantially interfered with.…*

On appeal,[87] the *trespass* and *negligence* convictions were overturned. The *nuisance* claim and *damages* were sustained, with the appeals court, again, recognizing the "character of the neighbourhood" as being more residential:

> *The trial judge determined that the quarry was in a rural area that had a mix of uses but which was primarily residential in character….In the present appeal, there is adequate evidence to support the trial judge's finding that the area was, in his words, "much more residential than commercial."*

*Miller Paving Ltd.*[88] was denied leave to appeal the OMB's October 27, 2015 decision, as no "question of law" was raised. In upholding the OMB decision imposing a 300 metre setback

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[87] *Moore v. Smith Construction Company, a division of the Miller Group Inc.*, [2013] O.J. No. 3768, <http://canlii.ca/t/g04d5>, retrieved on 2019-10-01. In *Lambrecht v. County of Will*, 217Ill. App. 3d 591 (Ill. App. Ct. 1991), 577 N.E.2d 789, the appeals court upheld the trial court's ruling to deny a quarry permit, which, in part, "found the existing uses of nearby property to be residential and farmland, with the land located north of the [subject] property being predominantly residential."

[88] *Miller Paving Limited v. The Corporation of the Township of McNab/Braeside et al*, 2016 ONSC 6570.

from the *property line* of nearby residences, the Superior Court of Justice (Divisional Court), stated, in pertinent part,

> *Section 4.1.1 [PPS] is for potential influence areas within which adverse effects may be experienced for industrial uses setting the distance for Class III at 1000 m. Section 4.3 recommended minimum separation distances for Class III at 300 m [para. 24].*
>
> *Miller has put forth the position based on the facts of the case and the decision of the OMB. In reviewing the decision, I do not agree that there is a question of law. The OMB was cognizant of the provincial interest as well as the expert opinions and the arguments of the property owners. The Province provided no evidence at the hearing. The Provincial Guidelines were just that guidelines.* ***The OMB considered the evidence and concluded as set out in the Official Plan, namely section 11(2) (3) concerning limiting the disturbance to the subject site.*** *Miller has not provided any authority to support its argument that there is a question of law. The decision of the OMB was one based on the evidence provided at the hearing and at best, is a question of mixed law and fact [para. 32].* [emphasis added]
>
> *There is nothing that has been presented by Miller that puts into substantial doubt the decision of the OMB on this issue. On reviewing the decision, there is ample evidence that the OMB used to support its decision. The OMB did not solely rely on the Guideline D-6.* ***There is nothing directed to this Court that the using of Guideline D-6 would bring the correctness of the OMB decision into serious doubt [para. 39].*** [**emphasis added**]

## Excessive Airblast & Ground Vibrations Resulting in Flyrock

Only 20 to 30 percent of the energy produced in quarry blasting is utilized to fragment and move rock mass. The remaining energy is wasted to create unwanted environmental impacts. Often, the factors that cause excessive airblast and ground vibrations have the potential to cause flyrock as well.

> ***Characteristics of Flyrock***
>
> *Flyrock involves the uncontrolled propelling of rock fragment produced by blasting. Institute of Makers of Explosives (IME) has defined flyrock to distinguish it from blast area accident. It is defined as the rock propelled beyond the blast area by the force of an explosion.*[89] *These rocks can travel distances of more than 600 m at speeds of up to 650 km/h.*[90]
>
> *Flyrock comes in different sizes and shapes, ranging in mass from few ounces to several tons. Persson et al. [1994] referenced flyrock weighing approximately three tons thrown to a distance of 980 ft. [299 m].*
>
> *Fly rock can be cast thousands of feet from a blast. The most dangerous source is ejection from a crack or weak zone in the highwall face where gases violently vent. This action is akin to a rifle where the expanding gases eject a projectile. Frequently the ejection of stemming out of the top of a blast hole is called rifling.*[91]

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[89] IME, "*Glossary of commercial explosives industry term"* (Washington, D.C.: Safety Publication No. 12, p. 16, 2007).

[90] H.C. Verakis, Flyrock: a continuing blast safety threat: *Proc. 37th Annual Conf. on Explosives and Blasting Technique*, International Society of Explosives Engineers, San Diego, 2011, 731-739.

[91] "Controlling the Adverse Effects of Blasting." https://www.osmre.gov/resources/blasting/docs/WYBlasterCertModules/8AdverseEffectsBlasting.pdf. (This blaster-training module was put together, under contract, with Federal funds provided by the Office of Technology Transfer, Western Regional Office, Office of Surface Mining, U.S. Department of the Interior, located in Denver, Colorado.) Much of the information in the module is derived from the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The performance standards apply to all surface coal mines. Similar standards have been adopted on some State and local levels and applied to non-coal blasting operations such as quarrying and construction.

*Flyrock is unpredictable and dangerous. Flyrock can travel in any direction or multiple directions from a blast.*[92]

*A rock that lands harmlessly in a field may not appear to be a large issue. However, mowing and tilling become hazardous when rock is struck by farm equipment. Rock through timber stands mar trees and potentially impact the market value.*[93]

*In areas of steep slopes, a rock set in motion by the explosive energy may roll hundreds of feet. In this instance the rock rolled through a trailer down slope from the mine. Children were playing in the front yard at the time. Fortunately no one was injured.*[94]

*Any size material is capable of damaging property or injuring people.*[95]

*…Where blasting causes the discharge of a contaminant, such as fly-rock, into the natural environment, blasting may harm people, animals or property. This is what happened in this case. A blasting activity gone wrong (as the appellant concedes) may not have caused more than trivial or minimal harm to the air, land or water. However, the fly-rock generated by the blasting did cause significant harm to property, a different adverse effect under the Act [EPA]. Importantly, the direct conduit resulting in this harm was the appellant's use of the environment (the air) to disperse a contaminant (fly-rock) [para. 76].*[96]

*The EPA seeks to achieve its goal of protecting the natural environment and those who use it through a series of regulations, prohibitions and reporting requirements. It also provides for a wide range of inspection, enforcement, preventative and remedial powers, such as the authority to issue control orders (s. 7), stop orders (s. 8), orders requiring the repair of damage (s. 17), preventative measure orders requiring steps to ensure that a discharge does not occur or recur (s. 18), or contravention orders requiring a discharger to take compliance steps (s. 157). [para. 11]*

*One of the means by which the EPA promotes its protective and preventative purposes is through the prohibition in s. 14(1) against discharging a contaminant into the natural environment where it is likely to have an adverse effect, and the related requirement in s. 15(1) that any such discharge which is out of the normal course of events be reported to the Ministry of the Environment. [para. 12]*

***As the interveners Canadian Environmental Law Association and Lake Ontario Waterkeeper pointed out in their joint factum, s. 15(1) is also consistent with the precautionary principle. This emerging international law principle recognizes that since there are inherent limits in being able to determine and predict environmental impacts with scientific certainty, environmental policies must anticipate and prevent environmental degradation.***[97] [emphasis added]

*Section 15(1) gives effect to the concerns underlying the precautionary principle by ensuring that the Ministry of the Environment is notified and has the ability to respond once there has been a*

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[92] http://www.killthealbionquarry.org/flyrock_danger.pdf.

[93] "Controlling the Adverse Effects of Blasting."

[94] "Controlling the Adverse Effects of Blasting."

[95] "Controlling the Adverse Effects of Blasting."

[96] *Ontario (Environment) v. Castonguay Blasting Ltd.*, 2012 ONCA 165 (CanLII), <http://canlii.ca/t/fqlt7>, retrieved on 2019-09-27. Castonguay Blasting Ltd. did not report the incident to the Ministry of the Environment, and was subsequently charged with failing to report the discharge of a contaminant ("flyrock") into the environment contrary to s. 15(1) of the Environmental Protection Act (the "EPA"). The appellant was acquitted, but the acquittal was reversed by the Superior Court of Justice and a conviction was entered. The conviction was upheld by the Ontario Court of Appeal. Leave to appeal to the Supreme Court of Ontario was denied. *Castonguay Blasting Ltd. v. Ontario (Environment)*, [2013] 3 SCR 323, 2013 SCC 52 (CanLII), <http://canlii.ca/t/g1038>, retrieved on 2019-09-27.

[97] O. McIntyre and T. Mosedale, "The Precautionary Principle as a Norm of Customary International Law" (1997), 9 J. Envtl. L. 221, at pp. 221-22; 114957 *Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (Town)*, 2001 SCC 40 (CanLII), [2001] 2 S.C.R. 241, at paras. 30-32.

*discharge of a contaminant out of the normal course of events, without waiting for proof that the natural environment has, in fact, been impaired [para. 20].*[98]

Often, the factors that cause excessive airblast (concussion) and ground vibrations have the potential to cause flyrock as well. For this reason, it is crucial that blasters understand and control the factors that can create flyrock. Some of the common causes of flyrock are:[99]

1) *Overloaded blastholes with excessive amounts of explosives*
2) *Heavily confined charges or the lack of relief (e.g. Lift blasts)*
3) *Explosives loaded into incompetent materials (egg. mud seams, fractures, and/or voids)*
4) *Insufficient front-row burden, causing front-face blowouts*
5) *Burdens and spacings too close together (resulting in high powder factors)*
6) *Inadequate/insufficient stemming material*
7) *Inadequate delay between holes in the same row or between rows; detonators firing out of sequence*
8) *Deviation of blast hole detonation from the intended sequence*
9) *Changing geology or rock type*
10) *Spacing and burden exceeds borehole depth*
11) *Angled boreholes*
12) *Secondary blasting*
13) *Human error, improperly loaded blasts*[100]

*Blasting has been, and continues to be, both an art and a science that relies heavily upon good judgement by the certified blaster in charge [p. 73].*[101]

*The fact is that flyrock will cause damage to the road, vehicles or even death to people or animals [p. 25].*[102]

The excessive throw of *rock* beyond the blast safety area is an environmental issue. Title 30 of the U.S. Code of Federal Regulations (CFR) defines 'Blast Area' as the area in which concussion (shock wave), flying material, or gases from an explosion may cause injury to persons. The CFR also states that the blast area shall be determined by considering the following:

1) *Geology or material to be blasted,*
2) *Blast pattern,*
3) *Burden, depth, diameter, and angle of the holes,*
4) *Blasting experience of the mine [personnel],*
5) *Delay system, powder factor, and pounds per delay,*

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[98] *Castonguay Blasting Ltd. v. Ontario (Environment)*, [2013] 3 SCR 323, 2013 SCC 52 (CanLII), <http://canlii.ca/t/g1038>, retrieved on 2019-09-27.

[99] "Controlling the Adverse Effects of Blasting," https://www.osmre.gov/resources/blasting/docs/WYBlasterCertModules/8AdverseEffectsBlasting.pdf. (This blaster-training module was put together, under contract, with Federal funds provided by the Office of Technology Transfer, Western Regional Office, Office of Surface Mining, U.S. Department of the Interior, located in Denver, Colorado.)

[100] In the *Matter of Mario Mastro v. Hudacs*, 224 AD 2d 621 (1996) 638 N.Y.S2d 681, the appellate court upheld the findings of the Blaster Examining Board "that insufficient stemming of the blast in question and the number of holes in the area that was blasted caused a flyrock to fall on a passing motorist severely injuring him." Mastro's competency as a blaster was at issue, and the Board issued "a one year suspension of his Blaster's Certificate of Competence and the requirement that he retake the blaster's examination." https://scholar.google.com/scholar_case?case=8561234087670744605&q=flyrock&hl=en&scisbd=2&as_sdt=2006.

[101] "Surface Blaster's Certification Study Guide," Virginia Department of Mines Minerals and Energy, June 2019.

[102] Quote from "Report: Blast Impact Assessment SQ1 Quarry, 20-Jan-2017 https://slrconsulting.com/media/files/documents/App4.2_Blasting.pdf.

6) *Type and amount of explosive material, and*
7) *Type and amount of stemming.*[103]

The CFR definition of blast area is purely qualitative, making it difficult to rely on the definition for enforcing blast area safety regulations.[104]

## Blast Exclusion Zone Safety Calculations – Protecting Quarry Workers

*Esen*[105] presents a flyrock model to determine the safe blast exclusion zone required to confine the occurrence of flyrock generated by bench blasts to inside the boundaries of a proposed quarry or quarry expansion.

> *Flyrock can be defined as the rock fragments which were projected beyond the clearance zone.* ***The clearance zone is the zone around a blast beyond which there should be no risk to personnel from flying rock fragments, and beyond which the blaster must evacuate all personnel prior to firing the blast*** *(Stiehr, 2011). [emphasis added]*
>
> *Flyrock is one of the most blast-related incidents seen at mine sites. Some Australian examples are listed below:*
>
> - *during a quarry blast, flyrock was projected more than 500 metres onto the Pacific Highway. A rock of approximately 100mm diameter was also projected onto a nearby property where it caused damage to a shed and parked vehicle;*
> - *a rock was thrown 1300 metres from a blast consisting of 89mm diameter blastholes;*
> - *flyrocks resulting from a trim blast at a gold mine caused significant damage to the four drills and one excavator which parked less than 150m from the blast;*
> - *at a gold mine, one of the blastholes caused flyrock hitting and braking the window of a drill rig which was located 181m from the blast;*
> - *a quarry blast had thrown material a maximum of 170 meters and striking the main office which was 150 meters from the blast and caused damage to building; [and]*
> - *a shotfirer was struck on the right side of his face by flyrock after a toe was blasted at a quarry. He was videoing the shot 75 metres from the blast area whilst sheltering behind a steel hopper with another person.*

The equations shown in Figure 10 [p. 9] can be applied to theoretically predict the flyrock distance likely to result from a blast, given the specific parameters of that blast, before applying the safety factor out of an abundance of caution to the theoretically predicted flyrock distance to determine the minimum blast clearance distance:

> ***Based on this prediction, a safety factor is applied to give a minimum blast clearance distance. The [on-site] safety factor applied for buildings and equipment is 2.0 [200%]. For humans the safety factor is 4.0 [400%].*** [emphasis added]

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[103] https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/fadtf.pdf.

[104] C. L. Eze and U. U. Usani, "Hard Rock Quarry Seismicity and Face Bursting Flyrock Range Prediction in the Granite and Migmatites Rocks of North Central Nigeria," *Int. Journal of Engineering Research and Applications* (December 2014): 1-6. https://www.researchgate.net/profile/Eze_Chibuogwu/publication/274008421_Hard_Rock_Quarry_Seismicity_and_Face_Bursting_Flyrock_Range_Prediction_in_the_Granite_and_Migmatites_Rocks_of_North_Central_Nigeria/links/5525b22f0cf295bf160eae0e/Hard-Rock-Quarry-Seismicity-and-Face-Bursting-Flyrock-Range-Prediction-in-the-Granite-and-Migmatites-Rocks-of-North-Central-Nigeria.pdf?origin=publication_detail.

[105] S. Esen, "Effective Fragmentation and Flyrock Control Strategies at Quarries," Conference Paper, 8th International Aggregates Symposium, October 2016, file:///C:/Users/Windows%207%20PC/Downloads/Effectivefragmentationandflyrockcontrolstrategiesatquarries.pdf. The predictive flyrock model was developed by Terrock Consulting Engineers.

For the protection of all onsite quarry workers, applying the safety factor of 4 (400%) to a theoretical prediction of flyrock calculated at a distance of 200 metres from the blast demands a minimum blast exclusion zone of 800 metres (200 metres x 4) within the boundaries of a proposed quarry or quarry expansion.

In the absence of a theoretically calculated on-site blast exclusion zone, *Esen* recommends the following guidelines for the protection of quarry workers:

- ***For nonblast personnel 800m in front of the shot and 400m to the side and rear of the shot.*** [emphasis added]
- ***Blast personnel should be positioned greater than 400 metres from the shot and not positioned in the direct line of fire and within retreat distance of a protective structure (i.e., fixed plant or blasting bell).*** [emphasis added]

## *Contaminants & Nuisances and Reliability of Testing Fugitive Dust*

Despite the public's growing need to know what toxic pollutants were being emitted by industrial operations into the soil, water and air, surface mines and quarries were exempt from preparing an emissions inventory for *Canada's National Pollutant Release Inventory* (NPRI).[106] Why surface mining and quarrying operations were exempted from the reporting requirements is unclear,

> *but it was likely a combination of industry lobbying, and substantive issues including the difficulty of characterizing certain emissions sources at mines. But with the addition of the seven Criteria Air Contaminants (CACs) - including particulate matter (PM) - to the list of reportable substances in 2001, this exemption was reconsidered (Environment Canada, 2006) [p. 1].*[107]

Quarries generate large quantities of *particulate matter* (PM), and allowing the quarrying industry to remain exempt from the reporting requirements was found to be unacceptable. In 2007, quarrying was added to the list of industries required to report on their emissions.

> *Particulate matter (PM) is the dominant airborne pollutant from surface mines and a substance notorious for its health consequences (In yang and Bae, 2006, Kon, et al., 2007). The true danger of PM is that substances stakeholders believe to be harmless --- like the limestone extracted from quarries --- can cause injury and death to humans, wildlife, and plants when in particulate form (Salvi and Holgate, 1999).*

It has been suggested that policy-driven data collection such as an emissions inventory is typically a perfunctory exercise fulfilling procedural requirements rather than scientifically validating quantification of the emissions values (Swart et al. 2007). According to *Weinstock*, scientific validity means applying an approach that will lead to accurate emissions reporting, which is something that the current NPRI pits and quarries guidance does not stress. PM emissions calculations are based on equations (AP-42) developed by

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[106] "Pits and quarries reporting guide," https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html.

[107] Aaron B. Weinstock, "Quantifying Dust Emissions From Limestone Quarries: Data Selection and Uncertainty Assessment," Thesis, 2009. https://digital.library.ryerson.ca/islandora/object/RULA%3A1692.

the United States Environmental Protection Agency (USEPA), which are based on meteorological data and material properties of questionable quality:[108]

> *The quality of these equations is questionable [p. 3-6], and USEPA admits (USEPA, 1995) that their completeness and detail is limited by the published references used to develop them. Even still, the USEPA and Environment Canada consider them to be appropriate for inventories and permit applications across a range of industries,...[including] surface mines…*

According to the Western Regional Air Partnership (WRAP), *dust* is defined as "particulate matter of a *geologic, organic* or *synthetic* origin that is, or has the potential to be, suspended in the atmosphere as a result of mechanical abrasion, wind erosion, or explosive activities [i.e., blasting]."

*Weinstock* measured emissions from *unpaved roads*, *material handling* and *storage piles* at three limestone quarries in Quebec using the AP-42 emissions factor method, while addressing the error of using 30-year climate averages, the uncertainly introduced by typical material properties and the limited availability of climate data.

> *When temporal resolution was increased by calculating emissions using a combination of daily and hourly climate data instead of the 30-year averages advocated by the NPRI, the differences in emissions calculated using the established procedure were not consistently higher or lower, but were source- and weather station-dependent. Compared to the 30-year climate average method, the use of daily/hourly climate data resulted in emissions from unpaved roads between 38.95% and 42.50% higher; emissions from materials handling that were between 15.31% lower and 18.64% higher, and emissions from wind erosion of storage piles were all lower by 12.48% to 37.50% [p. 110].*

Haulage truck traffic on unpaved roads represents about 50% of a quarry's total particulate emissions (Ghose, 2007), which based on *Weinstock's* calculations is significantly understated. In comparison, about 34% of all particulate matter in the atmosphere originates from traffic on unpaved roads (p. 22).

> *Unpaved roads are typically graded and compacted road beds or composed mainly of the underlying parent material (William et al, 2008). Dust is generated by the pulverization action of the wheels on road surface materials, with the dust discharge increasingly linearly in proportion to the amount of traffic (Western Regional Air Partnership, 2006). Williams et al. (2008) add that some uplift is also attributable to movement in the vehicle's wake [p. 23].*
>
> *In addition to a positive correlation with the amount of traffic, Watson et a!. (2000) cite two studies suggesting that dust emissions are negatively correlated with silt content of the road surface. This is in direct conflict with the formula adopted by the NPRI for calculating emissions from unpaved roads, as it positively correlates emissions with the siltiness of the road. These two studies suggest that roads with higher gravel content will have greater abrasive action and therefore have higher emissions (Watson eta!., 2000) [p. 23].*

In 2017, at Braeside Quarry. *Miller*[109] was again found liable for damages in *nuisance* for interference caused to the enjoyment and use of each homeowner's property, located nearby in a designated Settlement Area. The court heard from 21 witnesses over the course

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[108] "Fugitive Dust from Mining and Quarrying," https://www.epa.gov/sites/production/files/2015-08/documents/minqur3.pdf.

[109] *Battiston v Smiths Construction Company*, 2017 CanLII 77336 (ON SCSM), <http://canlii.ca/t/hnsh8>, retrieved on 2019-10-07.

of a twelve-day trial before issuing its ruling in favour of the homeowners. The interference caused by the operation of the asphalt plant arose from "*odour, noise* and *dust*" that significantly impacted all fourteen residents' ability to enjoy the "full" use of their properties. The court found that the interference was "substantial," meaning it was "non-trivial." Each resident testified that they would not have chosen to reside proximate to the quarry had they known how the operations of the temporary asphalt plant would affect them and discussed the issue of flyrock.

> *I base my conclusion that the interference was "substantial" based upon how the effects of the plant's operation impacted the plaintiffs. While the defendant produced records to support the fact that the noise / odour issues were not constant and that their complaints as chronicled in a diary would suggest occasions when odours or noise were not experienced daily, the bottom line is that it impacted the plaintiffs' ability to regularly enjoy their properties. They were no longer willing to continue with their gardens and outdoor activities due to concern of possible negative health effects and the unpleasantness of being outside when the odours and/or noise were present. The plaintiffs spoke of no longer planning social events (barbecues) because it was impossible to predict whether the plant would be operating. This hindered or ended planned activities.* ***In every instance, the plaintiffs testified, had they known the negative impact the operation of the temporary asphalt plant would have on them, that they would not have chosen to purchase their home [para. 19].*** [emphasis added]

As to whether the interference was reasonable, the court rejected *Miller's* defense of compliance with regulatory noise and odour emissions limits, finding that compliance with statutory limits does not make the interference complained of reasonable, commenting, in pertinent part, as follows:

> *Various factors such as the severity of the interference, the character of the neighbourhood, the sensitivity of the plaintiffs, the frequency and duration of the interference, and the utility of the conduct may be considered in making this determination, depending on the particular circumstances of the case. There is no finite list.* ***The focus, generally but not absolutely, is on whether the interference suffered by the plaintiffs is unreasonable, and not on whether the nature of defendant's conduct is unreasonable. [para. 22]*** [emphasis added]
>
> *[T]he defendant relied upon the third party investigations by both the Ministry of Natural Resources and the Ministry of Environment, which, for the most part, confirmed that there were emissions but which found that the noise and odour emissions from the plant were within acceptable statutorily mandated limits [para. 31].*

All fourteen homeowners were awarded damages. While recognizing that providing asphalt under a government contract has public utility, the court noted that *Miller* is a "for profit" operation. No evidence was presented to suggest that alternative locations for the portable asphalt plant were not feasible, even if less convenient. (para. 28) As observed by the court in the prior 2009 decision,

> ***A private, for-profit company should be required to pay the full cost of its operations without forcing the plaintiffs to effectively subsidize its business through the free use of their properties [para. 28].*** [emphasis added]

Although the OMB approved expansion of the Miller Braeside quarry to within 300 metres of the neighbouring residential properties, there is some doubt as to the reliability of the

"air quality" study prepared on behalf of *Miller* that supported the expansion.[110] An independent air quality assessment for the proposed Miller Braeside quarry expansion, unrelated to the parties involved in the dispute over the quarry expansion, appeared in the 2015 issue of Air Qual Atmos Health,[111] and recommended against the quarry expansion. The study sampled potential impacts of total suspended particulates (TSP) or particulate matter ($PM_{10}$). Typical emission sources include dust generated from excavations, quarry, drilling, grinding, gathering, conveyance, and truck loading.

> *The corporation most highly affected by emissions from the proposed expansion or even the present quarry site is the Arnprior Golf Club, which is located only 2.3 km to the east of the quarry, and the Arnprior Golf Club at Sand Point, which is located within 2 km north of the quarry. The closest residential area to the Miller Braeside quarry is the village of Braeside, which is located within 3 km southeast of the quarry site. Braeside is a dissolved municipality with 191 residents living in an area of 1.86 km2 (Statistics Canada 2013b). Located further southeast, within 8 km of the quarry site, is the town of Arnprior, which contains the closest hospital to the township of McNab/Braeside, the Arnprior and District Memorial Hospital which is situated 7.3 km away. With only a total land area of 13.04 km2, the town of Arnprior was recorded to contain a population of 8114 residents in 2011, which is greater than the entire population recorded for the township (Statistics Canada 2013a). In addition, nearby the quarry site in the southwest direction lies the city hall of the township of McNab/Braeside, situated 5.5 km away, and the McNab Public School, situated 6.8 km away. Across the Ottawa River, within 6 km north of the quarry site also lies the settlement of Norway Bay, which is part of the municipality of Bristol in Quebec, Canada [p. 575].*

TSP concentrations were simulated on various days throughout the year to address seasonal variations in 2003 and 2013. The TSP samplings generated the following findings:

> *[T]he spring day of April 15, 2003 was determined to have the highest 1-h average TSP concentration, while the summer day of July 11, 2003 was determined to have the highest 24-h average TSP concentration out of all 4 days analyzed. In the year 2003, the highest 30-min average TSP concentrations on January 12, April 15, July 11, and November 17 were determined to, respectively, be 1135.15, 1782.32, 1017.74, and 1393.65 µg/m3. These TSP concentrations all significantly exceed Ontario's MOE 30-min criterion of 100 µg/m3. Likewise, in the year 2013, the highest 24-h average TSP concentrations on January 12, April 15, July 11, and November 17 were determined to, respectively, be 132.86, 82.01, 146.07, and 104.9 µg/m3. The TSP concentrations on January 12, July 11, and November 17 are all well above Ontario's MOE 24-h criterion of 120 µg/m3, while the concentration on April 15 is well under this limit [p. 587-588].*
>
> *Taking these 4 days as a representation of each season, it can be concluded that overall the predicted maximum TSP levels are not within the limits of the applicable standards. In addition, it should be noted that with the changing seasonal weather, TSP concentrations may even exceed the concentrations determined in this study and disperse further from the quarry [p. 588].*
>
> ***During the hours or days where TSP concentrations are high, citizens residing, working, or touring nearby the [Miller Braeside] quarry would experience serious adverse TSP effects. In particular, children, the elderly, and citizens allergic to TSP experience the most hazardous effects of TSP. Unfortunately, many residential areas, in addition to both a hospital and school, are found to be located within close proximity to the quarry [p. 588]***.[emphasis added]

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[110] The 2008 *Operations Manual for Air Quality Monitoring in Ontario* remained in effect until June 30, 2018, with the revised manual taking effect July 1, 2018. The Manual is based on the procedures used by national agencies such as Environment and Climate Change Canada (ECCC) and the United States Environmental Protection Agency (US EPA). https://www.ontario.ca/document/operations-manual-air-quality-monitoring-ontario-0.

[111] Sabah A. Abdul-Wahab, Hedia Fgaier, Ali Elkamel and Keziah Chan, "Air quality assessment for the proposed Miller Braeside expansion in Canada: TSP," *Air Qual Atmos Health* (2015) 8: 573-589.

Short of a number of suggestions, the independent third-party study undertaken by the academic community nevertheless concluded that,

> ***[I]n its current proposed state, it is not recommended that the proposal for the expansion of the Miller Braeside Quarry be approved as a result of health and safety issues [p. 588].*** [emphasis added]

## Quarries in Other Jurisdictions – Air & Noise

Quarries in South Australia and Western Australia must comply with the following setback requirements for *air* and *noise* quality, with a greater setback imposed if blasting is involved:

> *…separation of 500 metres based on "air" (South Australia) or 1,000 metres (Western Australia) to 3,000 metres (South Australia) based on "noise" if blasting is involved [p. 53].*

Quarries are a contentious land use, and, according to the Medical Officer of Health for the Halton Region Health Department,[112]

> *Human health impacts from exposure to particulate matter ($PM_{10}$: particulate matter, including coarse particulate, less than 10 microns, and $PM_{2.5}$: fine particulate matter less than 2.5 microns) are well documented (see Appendix 1) and from a health protection perspective it is important to know not just the maximum air levels, but also how frequently high levels of particulate matter occur and how long they last [p. 53].*
>
> ***It is commonly understood that there is no level of exposure to coarse ($PM_{10}$) or fine ($PM_{2.5}$) particulate matter that is without negative health impacts [38]***.[emphasis added]

Poor air quality can affect all people, but

> *it is the young, the elderly, and those with existing health problems who are more likely to become ill, be hospitalized, or to die prematurely in response to poor air quality [p. 2].*

For the protection of human health and sensitive receptors, Halton Region's Medical Officer of Health recommends that quarry applications include,

> *a modelled frequency and duration analysis, which includes $PM_{2.5}$ (to understand how frequently and how long air levels can be expected to approach the maximum air levels); and*
>
> *background air concentrations of $PM_{2.5}$ in the modelling analysis (to enable the assessment of additional emissions from the quarry and a comparison to the Canada Wide Standard which is an ambient air standard) [p. 53].*

## Analogous Setback Requirements – Wind Farms

In *Wainfleet Wind Energy Inc. v. Township of Wainfleet*,[113] the court addressed a municipality's jurisdiction in enacting by-laws. The Township passed a by-law pursuant to the *Municipal Act, 2001*, S.O. c.25, setting out three restrictions against the construction, erection or operation of any Industrial Wind Turbine (IWT):

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[112] Bob Nosal, "Protecting Health: Air Quality and Land Use Compatibility," *Halton Region Health Department*, 2009. < https://opha.on.ca/OPHA/media/Resources/Resource%20Documents/AirQuality_LandUse-Feb09_2.pdf?ext=.pdf> retrieved 2019-11-17.

[113] *Wainfleet Wind Energy Inc. v. Township of Wainfleet*, 2013 ONSC 2194 (CanLII), <http://canlii.ca/t/fx2wd>, retrieved on 2019-12-23.

1. *Minimum setback of 2 kilometres from any property measured from the tip of the rotor blade in horizontal position;*
2. *Noise emitted by the IWT not to exceed 32dB at the nearest property; and*
3. *The Developer to provide an indemnification of 100% for any loss of property value or adverse health effect directly or indirectly caused by an IWT.*

The substance of the by-law deals with *setback* and *noise,* two of the many issues encountered when processing permit and licence applications from the aggregate industry.

*Property* is defined in the by-law to mean "*property line, vacant land, dwelling or structure and their inhabitants of all species used for private or business or public purposes*." With the exception of *property line*, the balance of the terms lack clarity. Accordingly, the court ruled the by-law invalid for "vagueness" and "uncertainty," as the other terms relating to "property" defied the court's ability to "provide a basis for legal debate and reasoned analysis."

However, the court recognized that municipalities may exercise both broad and specific powers pursuant to the *Municipal Act*, including the passing of by-laws provided they are not in conflict with provincial legislation.

> ***Subsection 8(1) of the Act requires municipal powers to be interpreted broadly "so as to confer broad authority on the municipality to govern its affairs as it considers appropriate and to enhance the municipality's ability to respond to municipal issues [para. 27]."***
>
> ***Subsection 11(2) states that a municipality is empowered to pass by-laws concerning its economic, social and environmental well-being and the health, safety and well-being of persons [para. 28].***
>
> ***Subsection 128(1) provides that a municipality may prohibit and regulate matters that in the opinion of council are or could become or cause public nuisances. As well, Section 129 entitles a municipality to prohibit or regulate noise and vibration [para. 29].*** [emphasis added]

As for the applicant's contention that the by-law is, in effect, a zoning by-law masquerading as one focused on *health*, *safety*, *noise* and *nuisance*, arguing that the *Planning Act* prohibition should apply, the court responded as follows:

> ***Although setback distances and control over the construction of structures is often a zoning matter, there is no reason why parallel jurisdiction cannot exist between the Planning Act and the Municipal Act, 2001 when different considerations are engaged***. [emphasis added]

As noted by the court, the province has relied on significant scientific evidence and public consultation in arriving at the 550-metre minimum setback distance for IWTs from *noise receptors*,[114] as defined in Section 4, Regulation 359/09 of the *Environmental Protection Act*.

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[114] *Noise Receptor* locations are the centre of a building or structure containing one or more dwellings; centre of a building used for institutional purpose, including educational facility, a child care centre, a health care facility, a community centre or a place of worship; centre of a proposed building or structure (as previously mentioned) for which a permit has been issued; a location on an accessible lot zoned to permit a building or structure (as previously mentioned) where a building would reasonably be sited, having regard to the zoning by-law and the typical building pattern in the area; and a portion of a property that is used as a campsite or campground at which overnight accommodation is provided by or on behalf of a public agency or as part of a commercial operation.

Ontario's Divisional Court[115] has reviewed and approved the process establishing setback requirements for IWTs, and noted that if anyone wishes to challenge a proposed project based on health concerns, they can do so as part of the provincial application process.

Independent studies or consultations have not been undertaken by the province in connection with the risk and potential adverse effects occasioned by blasting quarries, even though they share some of the same concerns involving IWTs. But, as documented in other jurisdictions, the adverse effects, including flyrock, from quarry blasting can often have much greater impacts on the environment and the health and safety of the public, warranting a setback greater than 550 metres.[116]

### Analogous Setback Requirements - Medical Marihuana Production Facility

The Phase 2 Strategic Directions Report, as Part of the Comprehensive Zoning By-law Project for the City of Markham,[117] deems a medical marihuana production facility a *sensitive use* requiring an 800-metre setback:

> ***5.8 Medical Marihuana Production Facility***
> *It is recommended that a medical marihuana production facility can only be located in a General Employment Zone and required to be no closer than 800 metres from a sensitive use, or any Residential or Mixed Use zone and that the operation is located in a single tenant building [p. 41].*
>
> *The recommendation is based on an assessment of the conditions that are required to ensure that this type of facility can operate safely and in a secure environment and does not impact nearby sensitive uses. Since medical marihuana production is a relatively new activity, the assessment in Discussion paper 16A draws on limited emerging practice elsewhere [p. 41].*

The empirical evidence to support imposing an 800-metre setback requirement within the boundary limits of a proposed blasting quarry in an outdoor environment, where the dangers of blasting to the health and safety of local residents and the general public are well-documented, is more compelling than it is for a medical marihuana production facility enclosed in a building and not exposed to the elements.

## *Diminution in Property Values Near a Quarry*

In *M & N Materials, Inc. v. Town of Gurley, Alabama, et al.*,[118] the United States District Court issued summary judgment in favour of the Town of Gurley, upholding the Town's April 13, 2004 decision to annex a quarry operator's 266 acres and include the land in a zoning

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[115] *Hanna v. Ontario (Attorney General)*, [2011] O.J. No. 944 (Div. Ct.) at para. 29. <http://canlii.ca/t/2g1bl>, retrieved on 2019-12-23.

[116] The Divisional Court's confidence in the testing that resulted in the regulated setback requirement of 550 metres may have been unwarranted, as the 2016 CCSG study (Buffer Zone Considerations For Mining Development In Proximity To Human Populations) at p. 16-22 citing Wind Turbine Buffer Zones compiled by Ontario Wind Resistance documents 50 jurisdictions, only one of which, Clinton Town Council, New York, has a lesser setback of 318 metres, but it comes with a Property Value Protection Plan within five miles of the Potential Project Impact Area to be provided by the applicant.

[117] http://www2.markham.ca/markham/ccbs/indexfile/Agendas/2016/Development%20Services/pl160614/Appendix%20A%20-%20Strategic%20Direction%20Report.pdf

[118] *M & N Materials, Inc. v. Town of Gurley, Alabama, et al*, United States District Court, Northern District of Alabama, Northeastern Division, November 13, 2105, https://lanierford.com/images/NewsPDFs/federal-court-decision-gurley-alabama-quarry-case.pdf.

classification that does not permit use of the land for the purpose of operating a rock quarry. In support of its motion for summary judgment, the Town provided the following explanation:

> *The record shows that, to the extent that the Town acted to prevent quarrying on the property, such action was* ***motivated by an intent to promote the health, safety, morals, and general welfare of the Town's residents****. As early as June 2003, the Town Council heard from residents concerned about a quarry. An entire citizens' coalition formed around the quarry opposition, gaining more than 500 signatures on petitions and commanding large attendance figures at public events concerning the quarry. In July 2013, after numerous concerns were received from residents and after Brian McCord held a public meeting to discuss his plans, the Town Council enacted Resolution No. 216, which explicitly stated that the Town had*
>
> > **Serious concerns regarding the effects a rock quarry would have on (1) air quality, (2) damage from blasting to homes and businesses, (3) large volumes of traffic on Gurley Pike (the main service road for Madison County Elementary School, (4) damage to existing streets by heavy trucks (5) damage to the Town's water storage tank located on Gurley Pike**. [emphasis added]

On the issue of the potential hazards of flyrock from quarry blasting and the potential diminution in property values near a quarry, the Town presented the expert testimony of Jim Ludwiczak and Dennis Key, respectively, which this court previously admitted,[119] important extracts of which are presented below:

> *With regard to the property at issue in this case – i.e., the eastern face of Gurley Mountain, facing the Town of Gurley – it is my [Jim Ludwiczak] professional opinion, within a reasonable degree of blasting and geologic certainty, that flyrock is likely to occur and will be difficult to control.*
>
> ***I have seen flyrock occur in hundreds of other cases where conditions were similar to those encountered on Gurley Mountain. Some of these flyrock occurrences had some of the best blast designs I have ever seen, but flyrock still occurred. In some of [those] cases, flyrock traveled as far as 3,000 feet [914 metres], and frequently traveled 2,000 feet [610 metres].*** *Because there is a high risk of flyrock, it is necessary to evaluate the potential associated hazards. To begin, the topography of the area is very significant in that the face of the mountain proposed for quarrying directly faces the Town of Gurley and rises above the Town and associated structures. It also faces U.S. Highway 72, a major roadway with four lanes of traffic. The topography of the quarry zone therefore directs all adverse effects of blasting toward the Town of Gurley and its residents and motorists.* [emphasis added]
>
> ***Among the structures in the Town of Gurley that would be within [2,000 to 3,000 feet of where I would anticipate blasting would likely occur] are a public housing complex…, numerous private apartments and numerous private residences (many of which are designated historic), the Town of Gurley's water tank, two propane distribution operations, a restaurant, a gas station, an electrical substation, and the Madison County Elementary School and its playground and activity field….Moreover, there exist…TVA high voltage power lines running directly through the middle of the subject property, carrying high amounts of electricity at all times****. I personally inspected these lines during my site visit; these TVA towers and lines appear to be located within 250-500 feet from the area where blasting could be anticipated to occur*. [emphasis added]
>
> ***….When flyrock comes into contact with the [high voltage power] lines, it can cause "arcing" and swaying of the lines, which will result in fires and explosions, and can even result in tower failures.*** [emphasis added]
>
> ***[I]t is my judgment that residents of Gurley Gardens, nearby apartments, Elementary School students, and Town residents as a whole have a significant risk of exposure to flyrock if this***

[119] See doc. No. 120 (Memorandum Opinion and Order).

> ***quarry is operational. If such contact were to occur, it could well be fatal, and in several cases I have investigated, it has been.*** [emphasis added]
>
> *[I]t is my opinion as the former Chair of a Zoning Board of Adjustment and as an expert in the area of quarry operations and blasting that the Town properly enacted moratoria on the property in order to study the potential impact of a quarry, and ultimately zoned the property for "agricultural" use.*

In addition to Ludwiczak's expert opinion on the potential hazardous impacts of quarry blasting, Dennis Key[120] presented evidence addressing the negative impact on residential property values near a quarry:

> Dennis Key opined that **property values near the area would likely have decreased by up to 12.2 percent, *if* the operation of a quarry had been permitted under the zoning classification**.[121] [emphasis added]

The United States District Court concluded there was a rational foundation for the Town's actions, and rejected M & N's claim that the Town's actions constituted an unconstitutional taking of property without just compensation:

> ***The evidence presented in this case, including the expert testimony of Jim Ludwiczak and Dennis Key, shows that conceivable rational bases existed for: annexing the M & N property; enacting moratoria on business licenses for that property; and ultimately zoning the property for agricultural use. The reasons included preventing the diminution of nearby property values, preventing dangers such as flyrock and ground vibration, and avoiding interference with high-voltage TVA power lines.*** [emphasis added]

Key's Proximity Study entails grouped sales of modest detached single-family dwellings within 875± feet (267 metres) of the lot limit of a quarry that was operational when the sales occurred, compared to a group of comparable sales located beyond 875± feet of the lot limit of the operational quarry (i.e., the control group). Both groups of sales are from the same subdivision, *time-adjusted* to the effective date of appraisal (November 23, 2004), and were relied on to isolate the impact, if any, that the proposed quarry in the Town of Gurley would have on the value of nearby residences within 875 feet of the lot limit of the proposed quarry. Combined, the house sales in both groups range in price from $82,000 to $125,000. Based on the distance parameter of the Proximity Study, Key concluded that residences within 875 feet of the lot limit of the proposed quarry in the Town of Gurley would sustain an estimated 12.2% diminution (loss) in value, a rate that falls within the 10% to 15% discount suggested by two local and knowledgeable realtors.

The risk factors associated with a quarry operation, to which nearby homeowners are exposed, as identified in Key's Proximity Study, include the following:

- Quiet Enjoyment – Noise Issues
- Tresspass – Dust and Airborne Particles
- Structural Damage – Blasting
- Ongoing Monitoring – Determining Change of Structural Damage
- Market Resistence – Proximity Issues Resulting in a Diminution in Value

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[120] Dennis Key, SRA, is a designated member of the Appraisal Institute.
[121] Doc. No. 58-4 (Key Affidavit) ¶ 13.

The Proximity Study does not indicate the distance from the actual quarry activity (i.e. mining and blasting), a point that is more distant than the 875 feet measured from the lot limit of the operational quarry. Likewise, the distance of the planned quarry activity (i.e., mining and blasting) to its lot limits is not indicated. Adding the distance from the quarry activity to the lot limit of the operational quarry to the 875 feet beyond the lot limit of the operational quarry is the true measure of the distance variable or the sphere of influence on property values.

Furthermore, the Proximity Study does not reveal whether the purchasers in both groups of sales are aware of the potential hazards of flyrock, as identified and explained by Ludwiczak, the blasting expert. Purchasers relocating from major urban centres to a rural community like the Town of Gurley are unlikely to be aware of the potential dangers of flyrock from blasting. As an example, in an area of Miami, Florida that is notorious for property damage occasioned by quarry blasting a purchaser acquired his home unaware of a nearby quarry operation:

> *Bal Cheema has lived for 25 years in Marbella Park in Miami-Dade on the west side of I-75.* ***When he bought his house for $125,000, it was on the edge of swampland and he didn't know that the mining operation existed. Now his desktop computer shakes during blasts and his backyard tile has an inch-wide crack that "looks like it was caused by a freaking earthquake****."*[122] [emphasis added]

If some of the purchasers of the residences in both groups of sales are unaware of the dangers of flyrock, the expected loss in property value would be greater and extend beyond 875 feet, as this variable is not captured in the purchase price of every transaction. Buyers given the choice of selecting between two homes offered at the same price and similar in age, quality of construction, building materials, utility and lot size, would avoid choosing the one in proximity to a blasting quarry (or a non-blasting quarry).

A quarry is a disamenity[123] with significant environmental impacts, and houses available for sale near quarries are often stigmatized and disregarded (avoided) by prospective purchasers, resulting in limited marketability. Residences of similar utility increasingly distant from a disamenity are more desirable, enjoy greater marketability, achieve higher prices, and experience greater rates of price appreciation (preservation of homeowner equity) over time.

In another case,[124] involving a number of homeowners claiming damages against an operational quarry, Key and Maloy[125] conducted an analysis that examined price change over the 2010-2014 period for house sales in two subdivisions located one mile west of an operational quarry (non-impacted by an operational quarry), compared to the cumulative price change for the same period of sales in two similar subdivisions located just north of an operational quarry (impacted by an operational quarry). In both instances, price change

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[122] Linda Robertson, "'Are you in Miami or Syria?' Explosives shake homes, break windows, crack floors" Miami Herald, December 4, 2017, https://www.miamiherald.com/news/local/community/miami-dade/article187589028.html.

[123] **Disamenity**. Noun (plural **disamenities**) A disadvantage or drawback, especially of a location. "https://www.yourdictionary.com/disamenity.

[124] *Ronald Overton et. al., v. M.S. & R. Equipment Company, Inc., et al.*

[125] Richard Maloy, MAI, SRA, JD, is a member of the Appraisal Institute.

in the control subdivisions (non-impacted by an operational quarry) out-performed the price change experienced in the two impacted subdivisions (near an operational quarry). The cumulative change in price for sales in the non-impacted subdivisions was 11.1% and 18.63%, compared to -5.41% and 4.05% for the sales in the impacted subdivisions (near an operational quarry), summarized as follows:

- Price Change in Non-impacted Subdivisions: 11.1% and 18.63%
- Price Change in Impacted Subdivisions: -5.41% and 4.05%

It is well known in the real estate literature that environmental disamenities are likely to have financial impacts with larger effects in more expensive upscale neighbourhoods and more modest effects in less expensive neighbourhoods (e.g., Gayer; Reichert et al., 1992).

According to Toffey,[126] the initial introduction and addition of disamenities has a cumulative effect of stigmatizing and destabilizing a community, and causes house prices to decline:

> *There is a dynamic consideration to adding an initial disamenity [e.g., quarry] to an area. A well-known tendency is that blight begets blight.*
>
> *If a disamenity [e.g., second quarry] is added that is of little or no benefit to a community, there is a tendency to take the attitude that the disamenity harm is already done and that adding other disamenities is simply putting like things together as is the blight-begits-blight tendency. The bar will be lowered on what is considered an acceptable disamenity for future additions. The area of the disamenity is cast into a continuing downward cycle of increasing disamenity in the future.*
>
> *As an area acquires more disamenities, the satisfactions of people living near the area are directly decreased for the reasons above. An additional effect is that the area gets a reputation of being undesirable. People living away from the area, who are not directly affected by the disamenities, view the area as undesirable. The satisfaction of people living near disamenities is further decreased because they acquire the reputation as living in an undesirable areas.*
>
> *…[P]eople have become increasingly concerned generally about environmental disamenities, which would make them less willing to pay as much for properties where there are disamenities.*

In a large scale peer-reviewed study of the impact of rock mines (quarries) on residential property prices, the first of its kind,[127] Malikov, Sun and Hite documented a sample of 5,500 house sales that took place in Delaware County during the 2009-2011 period (roughly two years). Within the County are four surface rock (limestone) mines (quarries), three of which are no longer operational. The only operational mine (state mine: Del-5), at 510 acres, also happens to be the largest and is subject to blasting, which creates a far greater nuisance (hazard) than other types of surface mines.

> Given that the other mines in the county were no longer in operation by the period of our study and hence did not generate noise, dust and traffic, in our analysis we focus solely on the operational Del-5 mine, which is not only very large but is also located in an area of high urban development.

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[126] "Impact on Property Values and Tax Burden of the Proposed Dennison-Pratt Schist Quarry," https://halifaxvermont.com/wp-content/uploads/2013/11/Bartenhagen-N.-property-values-07-28-2015.pdf.

[127] Emil Malikov, Yiguo Sun and Diane Hite, "(Under)Mining Local Residential Property Values: A Semiparametric Spatial Quantile Autoregression," *Journal of Applied Econometrics* (June 22, 2018): 82-109. https://onlinelibrary.wiley.com/doi/epdf/10.1002/jae.2655.

Standard software was used to calculate straight-line distances from each property (sale) to the mine centroid of Del-5. The study found statistically significant property-suppressing effects of being located near an operational rock mine (quarry), which gradually decline to near-zero at roughly a 10-mile distance.

> *For residential property in the middle of the price distribution (r = 0.50), our estimates suggest that, between two identical houses, the one located a mile closer to a rock mine is predicted to be priced, on average, at about 3.1% discount.*[128] *The analogous average discounts for houses in the first and third quartiles of price distribution are around 2.3% and 3.4%, respectively. For an upscale property in the 0.95th quantile [$552,500 avg house price], it is at an astounding 5.1%. This is rather expected because of income sorting whereby higher-income households have higher ability to pay for better environmental quality: in this case, distance from a disamenity.*
>
> *Conversely, households with lower incomes and less expensive homes are perhaps more willing to substitute environmental quality for other, more necessary, house characteristics such as easier access to employment, including jobs in the environmental-externality-generating rock mining industry itself.*[129]
>
> *As a back-of-the-envelope welfare calculation using unconditional sample quantiles of house values corresponding to the fitted quantile functions,*[130] *the above discount estimates imply the average loss in property value associated with the house being located a mile closer to a rock mine ranging from $3,691 to $10,970 for houses within the interquartile range of price distribution. For more expensive neighborhoods in the 0.95th quantile, such losses can be, on average, as high as* $28,410.

A July 9, 2018 Supplementary Appendix[131] of the study includes the following statement:

> *Our estimates suggest that, all else equal, a house located a mile closer to a rock mine is priced, on average, at about 2.3–5.1% discount, with more expensive properties being subject to larger markdowns.*

A purchaser of a house in proximity to a proposed quarry (or planned quarry expansion) unaware or uninformed of the disamenity is likely to have overpaid for the property, as is a buyer who is unaware or uninformed about the dangers associated with blasting. When access to important information is asymmetrical, resting solely in the possession of the vendor (property owner or agent), a prospective purchaser is rendered incapable of making an informed decision.

> ***Uninformed buyers overpay, particularly when purchasing complex assets whose values are difficult to accurately quantify (Carlin et al., 2013). Uncertainty over value creates market environments that allow asymmetric information price effects to persist (Kelly and Ljungqvist, 2012)….Home buying is an area where the ability of households to gather and effectively use market information can have profound effects on housing decisions, through***

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[128] 5.28 thousand feet [one mile] times the mean estimate of 0.58% per 1,000 feet. The average discount estimates for other quantiles of house price are obtained similarly.

[129] Cohen and Coughlin (2008) discuss such positive employment accessibility effects associated with environmental disamenities which may counteract negative externality effects in the context of a noise-generating airport.

[130] And assuming a constant marginal willingness to pay.

[131] http://qed.econ.queensu.ca/jae/2019-v34.1/malikov-sun-hite/Malikov-Sun-Hite-Mining-Property-Values-Appendix.pdf.

> ***both the choice of mortgage product and the purchase transaction itself [p. 1]***.[132] [emphasis added]

A lender-commissioned appraisal in support of third-party financing might be of little or no benefit in identifying the dangers and financial consequences of purchasing a house in proximity to a blasting quarry, as most residential appraisers are unaware of the impact that such a disamenity has on property values.[133]

Accordingly, the price discounts indicated by the study undertaken by Malikov, Sun and Hite for properties impacted by the operational Del-5 blasting quarry are understated. (The price paid for property by an uninformed buyer does not satisfy one of the conditions of Market Value.)

## *Tax Assessments for Single-Family Dwellings Near Blasting Quarry Reduced*

In *Warren Tp. v. Suffness*,[134] the issue involved assessment appeals for three contiguous lots (2.76 acres, 757.98'/699.61' depth; 2.30 acres, 699.61'/654.09'; and 2.19 acres, 654.09'/609.19' depth), each improved with a single-family dwelling, abutting a blasting quarry to their rear. Sorich, the Township's appraiser, prepared estimates of value for each of the three single-family dwellings applying both the "market approach" and "cost approach," asserting that the estimates of value generated by the two valuation approaches "corroborated each other." As of 1981, the three single-family dwellings ranged in age from 12 to 17 years. The Tax Court Judge issued three substantially identical opinions, noting that none of the parties had presented any "additional appraisal testimony." The Tax Court Judge found that

> ***the "dwelling house" on each lot "has been affected by the noise and dust caused by the quarry operation," and "[c]racks in ... [each] house have occurred as a result of blasting operations at the quarry," which was in operation "on the October 1, 1980 assessing date."*** *He concluded "a deduction must be made for economic obsolescence [in addition to the allowance Sorich made for physical deterioration caused by wear, tear, age, and use]."* [emphasis added]

The Tax Court Judge accepted Sorich's "land" valuation for each lot, which was based on an analysis of comparable land sales, but disregarded Sorich's quarry proximity adjustment. He also accepted Sorich's "total depreciated cost of improvements." Sorich stated "that there was no functional loss in the utility of the homes because of the quarry's presence," inaccurately characterizing the quarry as a factor in assessing the utility inherent in the

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[132] Arno J. van der Vlist and Geoffrey Turnball, "Uninformed house buyers and foreclosures," *Working Paper 1503*, June 2015, https://www.researchgate.net/profile/Arno_Vlist/publication/291103181_Uninformed_house_buyers_and_foreclosures/links/569e135608ae16fdf07b73fe/Uninformed-house-buyers-and-foreclosures.pdf?origin=publication_detail.

[133] A word search in the Louise Lee Lum Library of the Appraisal Institute for "blasting quarry", "flyrock" and "disamenity" failed to produce any results. The word "disamenity" does not appear in *The Dictionary of Real Estate Appraisal*, 6th ed., Appraisal Institute, 2015.

[134] *Warren Tp. v. Suffness*, 225 N.J. Super. 399 (1988) 542 A.2d 931, https://scholar.google.ca/scholar_case?case=10694856670601680060&q=%E2%80%9Cquarry+blasting%E2%80%9D&hl=en&scisbd=2&as_sdt=2006

dwellings (structures), rather than as an element of obsolescence external to the improvements, themselves.

> *From his "total value" for each lot's land and improvements, the judge deducted "25% for the adverse effect of the easement and the proximity to the quarry" by allocating a 25% deduction from his total value of each lot's land and a 25% deduction from his total value of each lot's improvements. "In adopting this value by the cost approach," he found it was "consistent with the market approach as reflected by [the comparable] sales utilized by" Sorich.*

The appellate division of the Superior Court upheld the Tax Court's decision to apply its own judgment to valuation data submitted by experts in order to arrive at true (market) value, by deducting 25% from the land value estimate and 25% from the estimated cost of the improvements for the impacts of the nearby blasting quarry. In other words, the value of both the *lot* and *improvements* were equally impacted by the abutting blasting quarry.

> ***With regard to the quarry operated on the October 1, 1980 valuation date, the Tax Court Judge found that the "dwelling house" on each lot had been affected by the noise and dust caused by the quarry operation, and cracks had occurred in each house as a result of quarry blasting operations.*** *The Tax Court Judge had the right to apply his own judgment in making an independent assessment of the true values. His deduction from the value of each lot's improvements to account for the adverse effect of the lot's proximity to the quarry in the absence of expert evidence to support such a deduction is sustainable because it is so clearly logical and reasonable that the value of the improvement will be affected by the adverse quarry condition. The judge reasonably articulated why a deduction must be made, although he did not reveal how he arrived at his 25% deduction for quarry impact. Nonetheless, we are satisfied that the figure is not unreasonable or arbitrary in light of Sorich's deduction of 30% when considering the quarry's impact on the value of the land [para. 415].*[emphasis added]

In New Jersey "True Market Value" is synonymous with "Market Value," which is defined as,

> *"The most probable price in terms of cash or cash equivalency which a property will bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller, each acting prudently, knowledgeably and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:*
>
> - *Buyer and seller are typically motivated.*
> - ***Both parties are well informed or well advised, each acting in what he/she considers his/her own best interest****. [emphasis added]*
> - *A reasonable time is allowed for exposure in the open market.*
> - *Payment is made in cash or its equivalent.*
> - *Financing, if any, is on terms generally available in the community at the specified date and typical for the property type in its locale.*
> - *The price represents a normal consideration for the property sold unaffected by special financing amounts and/or terms, services, fees, costs or credits incurred in the transaction."*

## *Blasting Produces Carbon Monoxide Poisoning*

Explosives generate fumes and carbon monoxide (CO) during detonation. Gases are produced as a normal by-product of blasting operations regardless of the types of explosive materials employed. Normally, in open pit blasting or outdoor construction blasting, any gases generated are readily diluted by the atmosphere and the prevailing winds or air currents. However, according to a case study prepared jointly by the Pennsylvania Office of Surface Mining Reclamation and Enforcement and by the Pennsylvania Department of Environmental Protection,[135] blasting at an open pit mine led to carbon monoxide poisoning of a family in a residence distant 430 feet (131 metres) to 500 feet (152 metres) from the point of the mine blasting.

> *The distance to the home from the blasts on March 31, 2000, when the first CO incident occurred was about 500 feet and about 430 feet away for the second event. The house is founded in close proximity to the coalbed and the same stratigraphic unit being blasted. As the blasting pumped gas into the aquifer, the 36- inch diameter 28-foot deep well acted as a sump to collect the CO. Other than the highwall, this may have been the only other exit point available to the fumes since perched aquifer would be flanked on all sides by a less permeable surficial soils.*
>
> ***In April of 2000, two adults and their newborn infant, were poisoned by carbon monoxide in their home and received medical treatment at a Pennsylvania hospital. Carboxyhemoglobin levels were; child - 31%, father - 28%, and mother - 17%. Initially the furnace was blamed but after further review, blasting at a nearby coal mine was determined to be the source.*** *All other sources of carbon monoxide were ruled out. The blasting was about 400 feet from the house. The conditions that led to the migration of gas include: the blasts were highly confined, the geologic structure contained fractures that served as conduits for the carbon monoxide to reach a hand-dug well outside the house, and the well was atmospherically connected to the basement floor drains.*
>
> *[The r]esidence…is about 430 feet from the nearest blast and topographically sits at an elevation of 1370'. A hand-dug 36-inch diameter, cobble lined, well that is about 28 feet deep serves as the primary source of water. The well is located on the east side of the house nearest the mine (Figure 2).*
>
> ***On Monday, April 11, 2000, the family…[is] contacted the Pennsylvania Department of Environmental Protection (DEP) with a complaint of muddy water from blasting. During the initial site visit, the DEP inspector discovered that the family had suffered carbon monoxide poisoning on April 1, 2000. The family's carboxyhemoblogin levels from that exposure were reported by the Presbyterian Hospital in Pittsburgh to be: wife - 17%; husband - 28%; and infant (11 days old) - 31%.***
>
> *April 2, 2000 - the contractor who had installed a new furnace in September 1998, was called to check the furnace for fumes. They found 650 ppm [parts per million] in the basement, 450 ppm on the first floor, and 400 ppm on the second floor. The contractor informed the family that the carbon monoxide buildup in their home was a result of an inadequate furnace draft. They reworked the furnace flu and installed a power vent to ensure adequate draw. Furthermore, one of the basement windows was removed to provide fresh air to the basement. At this time the gas hot water heater was also replaced with an electric heater. As a future safeguard, the residents purchased two carbon monoxide detectors; one for the basement and one for the bedroom.*
>
> *April 17, 2000 - two blasts are detonated. The first blast, at 11:51, located approximately 430 feet from the home was followed by another blast at 14:02, approximately 475 feet away from the home.*
>
> *April 20, 2000, one blast was detonated at 13:45. About an hour later, the carbon monoxide detectors in the home sounded an alarm and reported carbon monoxide levels of 73 ppm in the basement and 46 ppm in the upstairs of the home. The family left the house.*

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[135] "Carbon Monoxide Poisoning at a Surface Coal Mine…A Case Study," https://www.osmre.gov/resources/blasting/docs/OSMREReports/ISEE2001CO3.pdf.

> *The local volunteer fire department was alerted of this incident. They arrived at 16:00 and found 72 ppm at the furnace. After venting the house, they restarted the furnace and got readings of 144 ppm at the furnace. Unaware of any other source of carbon monoxide in the area, they focused on the furnace because their training had taught them that the furnace is the most likely source of carbon monoxide in homes. As a precautionary action, the DEP inspector, requested that State Industries voluntarily cease blasting until an investigation could be conducted.*
>
> *On April 21, 2000 - the DEP Emergency Response Team (ER) was called in to assist. ER personnel sampled the air quality inside the house and from a 36" diameter, cobble lined, well. The investigators found that the highest concentrations were inside the home at the floor drains, the highest being 200 ppm. The well had 160 ppm….*
>
> ***ER vented the well with a high volume fan. They observed a negative air pressure in the basement floor drains. They concluded that the air coming out of the well was supplied from the basement and that the furnace could draw air from the well. Their investigation led them to believe that blasting was the source of the carbon monoxide.*** *The fan remained on the well for a few days until CO was no longer detected.* [emphasis added]

According to the National Institute of Occupational Safety and Health (NIOSH), 1,200 ppm of carbon monoxide (CO) is Immediately Dangerous to Life and Health (IDLH) and 35 ppm is a safe exposure over an 8-hour time for healthy workers in the workplace. Adverse health effects from carbon monoxide (an asphyxiant gas) are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen uptake. Normal carboxyhemoglobin concentrations are <2% for non-smokers and 5%-9% for smokers. At moderate concentrations, early symptoms may be nonspecific (e.g., headache, dizziness, weakness, nausea, visual disturbances, and confusion. At higher concentrations (>30%), carbon monoxide exposure may be fatal.

## *Cascading Effects and Hazards of Quarrying Stone in Karst*

The consequences of quarrying for stone in a karst terrain are generally environmentally catastrophic and irreversible, with the series of adverse effects felt well beyond the limits of the quarrying operation:

> *In karst environments, aggregate mining may alter sensitive parts of the natural system at or near the site thus creating cascading environmental impacts (Langer and Kolm, 2001). Cascading impacts are initiated by an engineering activity, such as the removal of rock, which alters the natural system. The natural system responds, which causes another impact, which causes yet another response by the system, and on and on. For example, aggregate mining in some karst might lower the water table, which will remove the buoyant support of rock that overlies water-filled caverns or other solution features, which might result in land collapse, which will create a sinkhole. Cascading impacts may be severe and affect areas well beyond the limits of the aggregate operation. Cascading impacts may manifest themselves some time after mining activities have begun and continue well after mining has ceased. Many of the impacts described below are cascading impacts.*[136]
>
> *…[A] common thread [of a karst terrain] is the dominantly subterranean drainage. The paucity of water flowing at the surface, a consequence of rapid infiltration underground through a network of discontinuities in the soluble rock mass, results in two important but contrasting points: the considerable value of karst water resources (representing about 25% of the drinkable supply in the*

[136] William H. Langer, "Potential Environment Impacts of Quarrying Stone-A Literature Review," *U.S. Department of the Interior and U.S Geological Survey* (Version 1.0 2002). https://pubs.usgs.gov/of/2001/ofr-01-0484/ofr-01-0484po.pdf. For a detailed overview of environmental issues associated with *Karst*, see *Living With Karst: A Fragile Foundation* published by the American Geological Institute, https://www.americangeosciences.org/sites/default/files/karst.pdf.

*world) is strongly counteracted by the ease with which human activities can negatively impact this precious resource. The same narrow discontinuities, and the larger dissolution conduits and karst caves, are the main pathways through which potential pollutants may travel swiftly to regional groundwater bodies, or directly to springs.*

*Contaminants can be introduced by means of dispersed infiltration as well as from point sources and are frequently transmitted with minimal filtering. This example, just one of the many natural and/or anthropogenic hazards that may affect karst areas, illustrates the fragility of karst environments. Their high vulnerability is further expressed by a very simple concept that is true for many other environments but probably shows its best evidence in karst: it is very easy to damage or destroy natural resources but restoration to a pristine situation is an extremely difficult and commonly impossible, task. Where some degree of remediation is possible, the economic cost is commonly very high.*[137]

*Estimating and mitigating potential risk prior to quarrying are difficult. Some geotechnical techniques may be unreliable owing to a high degree of anisotropy and heterogeneity in carbonate rock where secondary porosity (fractures) and tertiary porosity (dissolutionally enlarged openings) are the dominant avenues for groundwater circulation. Surficial geophysical investigative techniques, (e.g. electrical resistivity, ground-penetrating radar, seismic response, mapping of lineaments, etc.) are useful in characterizing a site in general terms, but they are rarely definitive. Borehole logging and geophysics, although very precise within each well, may not reflect the true nature of secondary and tertiary porosity within the footprint of the quarry. For similar reasons, pump tests conducted in wells that do not adequately represent the karst aquifer (i.e. intersect secondary and tertiary porosity) likely will not provide reliable data for environmental and risk assessment.*[138]

*…[W]e have investigated karst and collapse sinkholes at quarries in Paleozoic dolomitic limestone which have experienced flooding following a routine blasting event. In one example, flood waters entered through the floor of the quarry from a source that was initially unknown, but later determined to be a conduit connecting the quarry with a karst cavern network outside the pit and extending to a nearby river. Immediately following the blasting event, inflow originated from the dewatering of the karst aquifer, at a rate of about 15,000 gpm. The inflow carried with it eroded karst-fill from the cavern network and the sediment was deposited onto the quarry floor. Over a period of several weeks the inflow was observed to decrease corresponding to the rapid decline of the water table within the karst aquifer. Large areas of the limestone aquifer contained little or no karst and in these areas the water was unaffected by the inflow from karst. A water storage basin located between the quarry and river received pumpage from the flooding quarry and was observed to drain rapidly into a new sinkhole. This drainage may have led to further erosion of the interconnected subsurface voids, enlarging the continuous connection between the river and the pit, which we call the "**conduit**." Subsequent river inflow to the pit further eroded fill material from the conduit and the rate of inflow was observed to increase over the next several months to over 40,000 gpm.*[139] [emphasis added]

***The creation of permanent barriers by attempting to construct grout curtains across the conduit, has proven to be a technically challenging [and costly] problem. Our observations of grouting [quarry] remediation projects found them to be trying for both the site owner,***

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[137] M. Parise and J. Gunn, "Natural and anthropogenic hazards in karst areas: an introduction," *Geological Society, London, Special Publications*, (Volume 279, January 2007): 1-3. https://sp.lyellcollection.org/content/279/1/1.

[138] Ernst H. Kastning, "*Quarrying in Karst: Geotechnical Estimation of Environmental Risk*," Conference Paper 11th ASCE Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 2008.

[139] James L. Lolcama, Harvey A. Cohen, & Matthew J. Tonkin, "Deep Karst Conduits, Flooding, and Sinkholes: Lessons For The Aggregates Industry," S.S. Papadopulos & Associates, Inc., 7944 Wisconsin Ave., Bethesda, MD 20814, https://www.sspa.com/sites/default/files/images/stories/documents/LolcomaEtAl_Deep%20Karst%20Conduits.pdf.

> ***and the engineering firm implementing the remedy. The primary challenges lie in the erodeability of the soft sediment which remains in the cavern during the placement of a grout plug. During remediation, the plug material (e.g., roofing tar or cement grout) conforms to the surfaces of the fill material in the cavern, temporarily stopping the flow. Fissures immediately form in the soft sediment against the grout curtain. Water flowing through the fissure erodes the soft sediment leaving the plug suspended in sediment and useless. Attempts at forcing grouts (cement-type suspension grouts) into these fissures prior to placing the plug material into the flow conduit are only occasionally successful***.[140] [emphasis added]

A 2005 study of pits and quarries in Minnesota[141] identified a number of adverse hydraulic impacts associated with limestone quarries, examples of which are described as follows:

> *Two examples of the impacts of limestone quarries that require dewatering can be found in southeastern Minnesota. At Owatonna, Minnesota, the Fretham and Lundin quarries mine below the water table in the Galena limestone and are dewatered for mining.* ***Between 1985 and 1992, DNR Waters staff received several complaints about wells near the quarries going dry or losing pressure. (Pressure loss can be a symptom of a water level that has dropped too close to the level at which the pump is set. Drawdown during active pumping then brings the water level to the pump intake causing the pump to suck in air.)*** [emphasiss added]
>
> ***The investigation determined that these wells were also in the Galena limestone and were in fact being impacted by the dewatering. In order to resolve the issue, the quarry operators paid to have the homes connected to the City of Owatonna's water system. A second example is the Osmundson quarry in the Lithograph City Formation at LeRoy, Minnesota. This below water table quarry requires seasonal dewatering at 250 gallons per minute to 800 gallons per minute. When the quarry is being dewatered, Sweets Spring, approximately 325 yards to the southeast, stops flowing. Dye traces in 1993 and 1994 verified that the quarry pirates the ground-water flow to the spring***. [emphasis added]

## Potential Adverse Effects of Dewatering in Karst Environment

In 2003, the Environment Agency responsible for protecting and improving the environment in England and Wales undertook a comprehensive study of how to assess the hydrological impact of groundwater abstractions in connection with dewatering operations at quarries, mines and engineering works.[142] In certain hydrological settings, in particular a karst terrain, there are a number of considerations that have to be taken into account when undertaking an Hydrological Impact Appraisal (HIA), as there are greater risks of adverse environmental impacts.[143] When assessing groundwater extraction, it is not reasonable to pretend a karst aquifer is homogeneous and isotropic (i.e., having identical values in all directions).

> *Karst and fractured crystalline rock: Care needs to be taken when dealing with groundwater abstraction from karstic aquifers and fractured crystalline rock.* ***The assumptions inherent in***

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[140] Ibid (see Figure 4 – Remediation Costs vs. Quarry Inflow). "The cost of remediation of sinkholes and flooding inflows is staggering as compared to quarry revenues."

[141] J.A. Green, J.A. Pavlish, R.G. Merritt, and J.L. Leete, Minnesota Department of Natural Resources, Division of Waters, for the Legislative Commission on Minnesota Resources, 2005, https://files.dnr.state.mn.us/publications/waters/hdraulic-impacts-of-quarries.pdf.

[142] Boak R, Bellis L, Low R, Hayes P, McKelvey P, Neal S, "*Hydrogeological impact appraisal for dewatering abstractions*," Environment Agency, © 2007. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291080/scho0407bmae-e-e.pdf.

[143] Appendix 3 (pages 81-117) of the study is devoted entirely to the potential impacts of dewatering in Karst terrains.

***analytical equations such as those of Thiem and Theis usually break down, and it is no longer reasonable to pretend the aquifer is homogeneous and isotropic*** *(see Appendices 3 and 4) [p. 39].* [emphasis added]

*Karst: dissolutional features such as conduits, caves, sinkholes, and closed depressions can develop in any soluble rock type, including carbonate rocks such as limestones and dolomites, and evaporites such as gypsum, anhydrite and halite. Such dissolutional features give an aquifer karstic properties, and the assumptions built into many models and analytical equations (that the aquifer is homogeneous and isotropic, for example) break down.* ***There is far greater uncertainty when predicting impacts or interpreting monitoring data in karstic aquifers, and a slightly different approach to HIA [p. 15].*** [emphasis added]

*The subject of karst is introduced under Settings 1 and 3 in Figure A2.1. The development of karstic features in carbonate rocks can have dramatic effects on their hydrogeological behaviour.* ***When trying to predict the hydrogeological impacts of dewatering, the level of uncertainty encountered when dealing with karstic aquifers may be an order of magnitude greater than for most non-karstic aquifers. It will be seen later (in Appendix 3) that great care needs to be taken when developing conceptual models for quarries or mines in karstic rocks [p. 77].*** [emphasis added]

*Karst terrains are the product of enhanced groundwater circulation that has developed preferentially due to the solubility of the terrain. They can develop in any soluble rock type including carbonate rocks such as limestones and dolomites, and evaporites such as gypsum, anhydrite and rock salt (halite). Where any of these rocks are present, the underlying groundwater system may be karstic in nature.* ***Given the high vulnerability of karstified aquifers and the considerable difficulties in predicting the effects of groundwater abstractions in them, the precautionary principle indicates that groundwater systems developed in these rock types should be considered as karstified until this is proven not to be the case [p. 81].*** [**emphasis added**]

*Karst terrains can often be recognised by the presence of a distinctive suite of landforms including: limestone pavements and other small-scale surficial and sub-soil dissolution forms (termed karren), sinking streams, blind and dry valleys, closed depressions of a variety of sizes and origins, caves and springs (Quinlan et al 1991). Of these, the closed depression and dry valley are perhaps the most useful general indicators of karst.*

***…[A]lthough the presence of a distinctive karst morphology may indicate that the associated aquifer is actively karstic, this need not necessarily be the case. However, the precautionary principle should again be applied, with the aquifer assumed to be actively karstic unless it can be shown that it is not [p. 81].*** [emphasis added]

*Karst groundwater systems are unusual because they develop channel or conduit flow, that can give rise to very rapid and highly localised movement of groundwater. In carbonate rocks, there is a strong non-linearity in the rate of dissolution as chemical equilibrium is approached, so that some under-saturation persists if there is significant flow, allowing continuous dissolutional enlargement of the openings through which groundwater flows. Thus, any initially open pathways such as joints or bedding planes through which groundwater flows may be subject to dissolutional widening (Worthington 1999). Such enlarged channels are frequently organised into a dendritic, hierarchical, tributary network that feeds to major springs (Figure A3.1) (Bakalowicz et al 1995). Such hierarchical channel networks result from the strong positive feedback between the circulation of fluid and the rate of dissolution, which is primarily dependent on groundwater flux. Thus flow routes with large discharges tend to develop most rapidly, and capture flow from adjacent smaller openings that have higher heads, building a dendritic tributary network very similar to that of surface water drainage. Indeed, this analogy can be extended because, like surface rivers, springs fed by karst conduits can often have well-defined underground catchments, although these do not necessarily conform with the surface topography [p. 82].*

*…In carbonate aquifers, where dissolution is driven primarily by carbonic acid derived from the elevated carbon dioxide (CO2) concentrations present in the soil atmosphere (resulting from root respiration and bacterial decomposition of organic matter), this zone may be particularly pronounced. It is termed the epikarst aquifer or subcutaneous zone (Figure A3.1). In contrast to conventional aquifers, in karst there is substantial storage and redistribution of recharge within the*

*epikarst aquifer (Williams 1983; Smart and Friederich 1986).* ***Failure to recognise the significant contribution of this zone to the hydrological behaviour of the karst groundwater system can lead to substantial errors in forward predictions. There are however considerable difficulties in developing techniques to evaluate the importance of the epikarst aquifer at any individual site, and in the incorporation of its behaviour in predictive models*** *[p. 82].* [emphasis added]

*Karst aquifers are best considered as triple-porosity aquifers, although in some aquifers the smallest scale openings may not be hydrologically significant (Quinlan et al 1996; Worthington 1999). At the smallest scale is matrix porosity, comprising intercrystalline and inter-granular pores of small diameter (50-500 μm). At the intermediate scale are fractures that have experienced little or no dissolutional enlargement and have typical widths of <1 mm. Because of their small apertures, flow is laminar in both these types of opening. However, at the largest scale of dissolutional channels, apertures range from several millimetres in dissolutional fissures to metres in cave conduits, and under most head conditions flow is turbulent.* ***The development of turbulent flow in karstic channels is important because it allows sediment transport by groundwater flow, which may impact upon water quality. More significantly, flow can no longer be described using Darcy's Law (which applies only to laminar flow) and conventional approaches to groundwater flow modelling are inappropriate*** *[p. 82].* [emphasis added]

The nature and type of impacts of groundwater abstraction in karst aquifers (which exhibit groundwater flow in conduits) differ from those in aquifers where groundwater flow is predominantly intergranular in a number of ways:

- *Impacts on groundwater levels and flows: these are often of a much greater magnitude, because of the very high transmissivities of the conduits. The impacts also tend to be irregularly distributed, because of the highly heterogeneous distribution of transmissivity in karst aquifers. Larger impacts occur along the line of (and in the vicinity of) conduits, including at springs where the conduits discharge – potentially a long way from the dewatered excavation. Smaller impacts occur in areas more distant from conduits where intergranular and small fracture flow dominate – potentially quite close to the excavation being dewatered.*
- *Ground subsidence and collapse: lowering of groundwater levels can cause ground subsidence and collapse in karst terrain. Reduction of pore (or larger void) water pressures causes an increase in the effective stress borne by the aquifer or overlying materials (solid phase), and if the increased effective stress exceeds the strength of these materials, subsidence or ground collapse will occur. The collapse feature usually takes the form of a closed depression, called a sinkhole or doline.* ***Subsidence and formation of sinkholes in karst terrain can occur naturally or it can be human-induced through groundwater abstraction. However, Newton (1976) showed that, of an estimated 4,000 sinkholes formed in Alabama between 1900 and 1976, only 50 (about 1 per cent) were natural collapses [and that 99% (3,500) of the collapses are associated with ground-water declines caused by the withdrawal of large quantities of water by high yield wells and by pumping from quarries and mines.].*** [emphasis added]
- *Within aquifer' impacts: in contrast to aquifers where intergranular flow dominates, karst aquifers can contain features of geoecological value. These include rock-forms (such as speleothems) and hypogean fauna. Groundwater abstraction can endanger the favourable hydrological conditions for the formation and maintenance of these features.*

### ***Prediction of hydrogeological impacts in karst***

*For HIA, the critical issue is to determine whether or not conduit flow is occurring in the aquifer. Where conduit flow is present, most analytical equations and conventional groundwater modelling strategies are inappropriate and, if they are used, predictions of impacts will be highly uncertain. If conduit flow is not present, then more conventional techniques may still be applicable. It is worth emphasising again that, in the context of HIA, there should be a high burden of proof on a conclusion that conduit flow is not a feature of a groundwater system. The criteria that may be used to recognise aquifers that have conduit flow are as follows [p. 86]:*

- *Recharge to the aquifer occurs at discreet sink points.*
- *Hydrologically active caves are known from the area.*
- *Discharge from the aquifer is limited to a few discreet springs.*
- *The rate of groundwater movement, determined by tracer tests, is high (Figure A3.5).*
- *Tracer detection in observation wells is focussed at specific sites, rather than forming a general breakthrough curve.*
- *Flow in the aquifer is turbulent, as indicated by the calculated Reynolds number, or transport of suspended sediment to the springs.*
- *Under baseflow conditions, linear troughs are present in the piezometric surface mapped from boreholes*
- *Hydraulic gradients tend to decrease in a down-gradient direction in karst groundwater systems, whereas they tend to increase in non-karst (intergranular flow) systems. Such a pattern also implies a down-gradient increase in hydraulic conductivity.*
- *There is a non-linear relationship between spring discharge and water level observed in boreholes.*
- *There are abrupt changes in water quality at springs during recharge events.*
- *There are rapid changes in water levels in boreholes following rainfall (more indicative of concentrated recharge and conduit flow in unsaturated zone than in saturated zone).*
- *There are very large differences in the hydraulic conductivity determined at different scales within the aquifer.*
- *There may be marked differences between the isotopic and geochemical characteristics of water sampled from individual boreholes, and between these and springs.*
- *There is an anisotropic and heterogeneous response of observation boreholes to abstraction.*
- *There are non-linear relationships between drawdown in observation wells and the rate of abstraction from a pumping well.*

***It is important to recognise that with the possible exception of the results of tracer tests, none of these criteria provides an unequivocal indication of conduit flow behaviour, but where several of the criteria are met, the balance of interpretation should lie firmly in this direction****. To understand further the nature and application of these criteria, the reader is referred to two papers that provide contrasting (karst and non-karstic) interpretations of the hydrology of the Smithville PCB spill site [see comments below] in the Silurian Dolomites of the Niagara Escarpment, Ontario, Canada (Worthington 2002 and Zanini et al 2000).*[144] *There is also an interesting series of papers that debate the contribution of conduit flow in the very important Edwards Aquifer of Texas, USA (Halihan et al 2000; Mace and Hovorka 2000; Worthington 2002).*[145] *The consequences of incorrectly accepting the non-karst model are graphically illustrated by problems associated with the construction of interceptor sewer tunnels in Milwaukee, Illinois (Rovey and Cherkauer 1994,*[146] *Burke 2002; Day 2004).* [emphasis added]

> "Smithville PCB cleanup proposals weighed after $50 million and 15 years, Hamilton Spectator, Nov 5, 2015." [As reported in the article,] "a five-star cleanup of…[the] toxic-waste site in Smithville is out of the question because it would cost $500 million…says…[the] program manager of the Smithville Phase IV Bedrock Remediation Program…[of] a final plan for the site for the next 50 years….It's thought about 10,000 to 30,000 litres [of toxins] leaked into the ground and there is no known way to remove it cheaply. Also unknown are how best to contain it and how it moves in fractured rock….If the site is left as is, the fractured limestone will continue to allow water to pass over toxic material, picking up some PCBs….It currently costs $500,000 a year for the monitoring and containment of the polluted site….International attention, particularly from the United States, is focused on Smithville. Solutions found there could be applied worldwide, including at least 40 toxic sites in the Niagara region, says Bill

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144 https://www.thespec.com/news-story/6083137-smithville-pcb-cleanup-proposals-weighed-after-50m-and-15-years/.

145 See also Lindgren, R.J., Dutton, A.R., Hovorka, S.D., Worthington, S.R.H., and Painter, Scott, 2004, Conceptualization and simulation of the Edwards aquifer, San Antonio region, Texas: U.S. Geological Survey Scientific Investigations Report 2004–5277. https://pubs.usgs.gov/sir/2004/5277/pdf/sir2004-5277.pdf.

146 See also Dirk Schulze-Makuch and Douglas S. Cherkauer, Proceedings of a Boulder Symposium, 1995, Relation of hydraulic conductivity and dispersivity to scale of measurement in a carbonate aquifer, http://hydrologie.org/redbooks/a227/iahs_227_0223.pdf.

> Wertz, an engineering geologist with the State Department of Environmental Conservation. No one has figured out what to do beyond just leaving sites alone and containing them to some degree with underground walls….The U.S. Environmental Protection Agency has contributed $500,000 to Phase IV…[and] the money is being used by University of Waterloo…to determine underground water flow….Over 15 years, just 14 kilograms of PCBs have been removed by pumping water from the site into filters….Drill tests show the oil has spread several hundred metres from the site through fractured rock to a depth of about 21 metres or more….At first it hurt town real estate, but that has bounced back. Because the spill was near a town well, water is now brought by pipe from Grimsby, which was to some, a benefit of the disaster.

> *Great care is needed when using information from boreholes. Water level and aquifer properties such as transmissivity determined from boreholes are unlikely to reflect conditions in the conduit flow part of the aquifer as the probability of a borehole intersecting a conduit is very low. Worthington (1999) estimates the probability is between 0.0037 and 0.075 (based on maps of ten extensive cave systems), but this probably represents an overestimate, as the surveys include dry passage no longer actively involved in groundwater flow, and the examples are drawn from areas known to be highly cavernous. Thus, data from boreholes are likely to be unrepresentative and unreliable (especially if used to develop and test numerical models). In contrast, springs in carbonate aquifers are the natural output points for the conduit network, and thus provide a sampling point indicative of its behaviour. In terms of aquifer contamination, they also integrate conditions over a large area, and are thus more useful as sampling points than boreholes, the catchments for which are poorly known (and usually exclude the conduit system) [p. 87].*[147]

In 1987, the United States Department of the Interior in cooperation with the Erie County Department of Environment and Planning investigated the ground-water-level declines in the Onondaga Aquifer in Eastern Erie County since 1982.[148] The study found that dewatering in quarries had a significant impact on water levels surrounding the quarries, and caused a number of wells to go dry. Dewatering in the quarries was also responsible for the development of sinkholes.

> *Ground-water levels in the Onondaga aquifer declined during the fall of 1981 and summer and fall of 1982-85 near a 2.2-mile-long and 800-foot-wide land-surface depression in the eastern part of Erie County. More than 60 wells and several wetlands went dry, and at least three sinkholes developed. Ground-water levels were measured in 150 wells during a high-water-level period in April 1984 and a low-water period in October 1984. Water levels fluctuated 20 to 50 feet near the depression and near quarries but fluctuated only 5 to 10 feet elsewhere. The water-level decline is caused by the combined effect of ground-water removal by pumpage from a quarry (the water is then discharged to Dorsch Creek) and by the diversion of some water of Dorsch Creek since 1981 away from swallets [underground streams] in the 2.2-mile-long depression area, which are recharge points for the aquifer. In 1982, sinkholes formed in a surface-depression area in Harris Hill. The enlargement of sinkholes in the Harris Hill area seems unrelated to the water-level decline in the eastern part of the county and is probably caused by local drainage alterations [p. 1].*

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[147] "Unlike an array of boreholes, an excavated quarry will intersect every fracture within its volume and footprint (Figure 5)….[W]here there is an appreciable flow of groundwater in fractures, water will enter the quarry pit and…eventually flood the excavation to the level of the surrounding potentiometric surface. If water is continually pumped from the pit during quarrying activities, and if inflow is not impeded by grouting or other measures, groundwater will continue to flow toward the quarry. This will result in lowering of the potentiometric surface within the zone of influence and may lead to reversal of flow direction in outlying parts of the aquifer. Nearby surficial water bodies (lakes, ponds, reservoirs, streams) may then lose water to the quarry through the fracture network (Figure 6). In a worst-case situation, excessive discharge into the quarry from contributing fractures may render the operation logistically or economically untenable (Kastning 2008). *Quarrying in Karst: Geotechnical Estimation of Environmental Risk*, Conference Paper 11th ASCE Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst.

[148] Ward W. Staubitz and Todd S. Miller, "*Geology and Hydrology of the Onondaga Aquifer in Eastern Erie County, New York, With Emphasis on Ground-Water-Level Declines Since 1982*," https://pubs.usgs.gov/wri/1986/4317/report.pdf.

*The area where water levels declined is underlain by the Onondaga Limestone an important aquifer that, in eastern Erie County, supplies water to approximately 750 households, 20 commercial and industrial facilities, and many farms. The Onondaga aquifer is a major source of water supply elsewhere in New York State (fig. 1) and is particularly important because it provides water of suitable quality for most uses. Water in the underlying Akron and Bertie Dolomites and Camillus Shale is less desirable for most uses because it contains elevated levels of hydrogen sulfide and dissolved iron and manganese [p. 1].*

*The walls of quarries show where prominent joints occur in the Onondaga Limestone. A quarry in the southwestern part of the study area (pi. 1) has large seeps of water from two prominent bedding planes; one was observed on top of the cherty Clarence Member (altitude about 625 ft), and the other was reported by the quarry operator to be at the base of the Onondaga (altitude 565 ft), where water cascades into a sump pit [p. 20].*

*Most vertical joints extend several tens of feet laterally, but some extend for several miles. A quarry that previously occupied the site of Spaulding Lake, north of Main Street in the Town of Clarence (pi. 1), was abandoned when mining intercepted a major vertical joint from which large volumes of water flooded the quarry. The joint's trend is N43°W and is traceable on air photos from the escarpment at County Route 216 (Old Goodrich Road) to Tillman Swamp [p. 20].*

*Quarries. Pumping for dewatering at three quarries that mine the Onondaga Limestone results in significant ground-water discharge from the Onondaga. Two quarries are in the southwestern part of the study area, and one is in the eastern part (pi. 1). Two quarries are pumped all year (the eastern and extreme southwestern quarries); the other is not pumped during the summer and early fall, when ground-water levels are below the quarry floor. Water pumped from the two southwestern quarries is discharged to Ellicott Creek through drainage ditches (pi. 1), and water pumped from the eastern quarry is discharged into Dorsch Creek, which flows 5.0 mi southwestward to Ellicott Creek [p. 28].*

*The daily average pumpage from the quarry in the eastern part of the area (at the Genesee-Erie County border) from June 1984 to July 1985 was 5.3 Mgal/d. Water levels indicate a 5- to 25-ft-deep cone of depression within 1,000 ft of the quarry (pi. 3). Ground water flows into the quarry from the north, east, south, and southwest. On July 24, 1985, water levels in wells within 500 ft of the quarry ranged from 784 to 788 ft above sea level. Since quarry operations began in 1958, several wells close to the quarry have been deepened (pi. 1) because pumping from the quarry had caused the water level to fall below the pump intakes. Projecting the regional hydraulic gradient of unaffected areas to the quarry indicates that the natural water levels in the area would be 800 to 810 ft above sea level during the summer. Without the pumping, the natural direction of ground water flow would be northwestward and westward [p. 28].*

*The pumping has lowered ground-water levels by 5 to 35 ft within 3,000 ft of the quarries (pi. 3). During the winter, when the pumps are shut down at the quarry east of Barton Road, water levels rise to altitudes from 700 to 710 ft (Todd Giddings and Associates, 1980), which is 5 to 15 ft below land surface [p.28].*

***Water levels in parts of the Onondaga aquifer declined during the fall of 1981, and several wells became dry. Water levels declined again during the summer and fall of 1982-85, and more than 60 wells and several wetlands became dry. The depth of wells that went dry ranged from 30 ft to 77 ft and averaged 50 ft. Most of the wells that went dry were deepened another 25 to 80 ft; the average was 45 ft. The depth of redrilled wells now ranges from 72 to 130 ft and averages 95 ft. Most of the deepened wells are completed in the lower part of the Onondaga, but several of the deeper ones are in the Akron and Bertie Dolomites [p. 30]***. [emphasis added]

***The water-level measurements revealed that water levels declined 30 to 50 ft during the summers and falls of 1982-85 in the vicinity of the channellike depression in the eastern part of the study area and in an apparent extension of the channel into the central part of the study area. Water levels elsewhere declined less than 10 ft. Most of the wells that became dry and were redrilled since 1981 are within 2,500 ft of the center of the depression and extend as a belt at least 3 mi long from Ayers Road to North Millgrove Road (pi. 4)***. *The*

*channel may extend west another 2 mi to Tillman wetland, but west of North Millgrove Road it may be buried by unconsolidated deposits [p. 30].* [emphasis added]

*Causes of water-level declines in the channellike depression area….Before the quarry at the Erie-Genesee County line was opened, ground water flow probably followed land surface and the direction of surface drainage westward and northwestward to and then beneath the channellike depression. Although the quarry is upgradient of the depression area and intercepts some of the ground water that would have flowed to it, no significant water-level declines were reported west of the quarry from 1958 to 1981. However, at least part of the water pumped from the quarry and discharged to Dorsch Creek during this period flowed northwestward in a small channel that branches off Dorsch Creek near Ayers Road; the water then flowed back into the Onondaga aquifer through several swallets in the easternmost extension of the depression area (fig. 6).* ***Some of the water pumped from the quarry was, in effect, returned to the aquifer through the swallets in the channellike depression and thus did not constitute a major loss from the system. During the summer of 1981, however, channel clearing routed all flow in Dorsch Creek southwestward, away from the swallets in the channellike depression area. Since then, all quarry pumpage carried by Dorsch Creek has flowed into Ellicott Creek and none flows through the now-abandoned channel to the swallets. Therefore, since 1981, none of the water removed from the quarry returns to recharge the ground water in the Onondaga aquifer in the depression area [p. 30-31].*** [emphasis added]

***Shortly after the 1981 diversion of water in Dorsch Creek from the swallets, several wells near the channellike depression were reported to go dry. During the summers and falls of 1982-85, ground-water levels near the depression again declined, but more severely than in 1981, and caused several wetlands and more than 60 wells to go dry. The diversion of recharge away from the depression area evidently has stressed the equilibrium of this part of the aquifer and caused a loss of storage in the aquifer, as reflected by the water-level declines. The reason that ground-water fluctuations near the depression are greater than in the surrounding areas is that the bedrock within the channel area has a high density of solution-widened joints and is therefore more permeable than elsewhere.*** [emphasis added]

*Causes of water-level declines near the quarries.* ***Water levels declined 5 to 30 ft in the vicinity of the three quarries as a result of the dewatering operations. The seasonal dewatering affected water levels within a 3,000-ft radius of the western quarries and within 1,000 ft the eastern quarry. Several wells near the eastern quarry (at the Erie-Genesee County line, fig. 1) had to be deepened as a result of water-level declines after the quarry began operation in 1958 [p. 32].*** [emphasis added]

***Although sinkholes have developed naturally throughout geologic time, they have formed with increased frequency in the past 50 years as a result of large ground-water withdrawals. For example, in some areas underlain by carbonate rocks in Alabama, where sinkhole formation has been extensively studied, an estimated 4,000 individual sinkholes and areas of subsidence have developed since 1900 (Newton, 1977). All but about 50 of these are defined as human-induced sinkholes and are associated with ground-water declines caused by the withdrawal of large quantities of water by high-yield wells and by pumping from quarries and mines (Newton, 1976) [p. 32]***. [emphasis added]

*The formation of sinkholes is usually preceded by or coincident with the lowering of ground-water levels or an increase in the range of water-table fluctuations. Initially, when the water levels are high, solution-widened openings are filled with water and residual particles of chert, clay, and other insoluble minerals as well as particles from overlying unconsolidated deposits. Both the water and residual material in the solution-widened openings serve to support the overlying bedrock and unconsolidated deposits, and their presence tends to restrict infiltration of water from above. When ground-water levels are lowered, such as through heavy pumping, the potentiometric gradient is increased, and the velocity of ground-water flow accelerates toward the discharge area, which results in the dewatering of the openings and subsurface erosion of the residual material within them (Newton, 1977) [p. 32-33].*

*The loss of structural support (hydrostatic pressure) in the solution-widened openings and in pore spaces in unconsolidated deposits by evacuation of water may cause a collapse of the opening or*

*collapse of unconsolidated sediments into openings of the underlying bedrock, which results in abrupt subsidence at land surface. If the unconsolidated deposits consist primarily of sand and gravel, this process generally results in a gradual subsidence at land surface that forms a depression with low-angle slopes, but if they consist of silt and clay, this process results in the sudden formation of steep-sided, conical sinkholes, as depicted in figure 7. Clayey silt or clay are relatively cohesive and can support a substantial weight, but as the sediment in the lower part of the deposit gradually spalls into the openings in the bedrock, a cavity is formed that becomes larger until the weight of overlying material can no longer be supported, at which time it collapses, forming a sinkhole [p. 33].*

*If unconsolidated clayey deposits above a vertical joint are subjected to repeated wetting and drying, such as by a widely fluctuating water table, desiccation cracks develop, and spalling will occur more rapidly. An increased range of water-level fluctuations has been reported to be caused by seasonal dewatering of quarries and mining (Newton, 1976) and also by diversion of storm runoff into sinkholes (Reitz and Eskridge, 1977), both of which occur in Clarence [p. 33].*

## Interference with Home Owners' Reasonable Use of Groundwater

In 1982, Charles and Elsie Paul, along with fifty other homeowners filed a law suit against American Aggregates Corporation. The homeowners alleged that the corporation in the conduct of its business of quarrying limestone had caused the level of the water table in the artesian aquifer underlying the homeowners' land to drop, causing problems with both the *quantity* and *quality* of water in their wells. The Ohio appeals court found in favour of the owner of the quarry, applying the "English Rule"[149] of non-correlative rights with respect to groundwater in *Frazier*:[150]

*[T]here are no correlative rights existing between the proprietors of adjoining lands, in reference to the use of the water in the earth, or percolating under its surface. Such water is to be regarded as part of the land itself, to be enjoyed absolutely by the proprietor within whose territory it is; and to it the law governing the use of running streams is inapplicable.' Id. at 308.*

On appeal, the Ohio Supreme Court[151] overturned the lower court's ruling, recognizing the injustice of such a policy to innocent homeowners, stating, in part,

*If the English rule is to obtain, a man may discover upon his own land springs of great value for medicinal purpose or for use in special forms of manufacture, and may invest large sums of money upon their development; yet he is subject at any time to have the normal supply of such springs wholly cut off by a neighboring landowner, who may, with impunity, sink deeper wells and employ more powerful machinery, and thus wholly drain the sub-surface water from the land of the first discoverer."*

*"Traced to its true foundation, the rule is simply this: that owing to the difficulties the courts will meet in securing persons from the infliction of great wrong and injustice by the diversion of perlocating [sic] water, if any property right in such water is recognized, the task must be abandoned as impossible, and those who have valuable property acquired by and dependent on the use of such water must be left to their own resources to secure protection for their property from attacks of their more powerful neighbors, and failing in this, must suffer irretrievable loss; that might is the only protection.*

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[149] *Acton v. Blundell* (Exch. 1843), 12 M. W. 324, 152 Eng. Rep.1223. See, also, Note, Establishing Liability for Damage resulting From the Use of Underground Percolating Water: *Smith-Southwest Industries v. Friendswood Development Company* (1978), 15 Houston L. Rev. 454.

[150] *Frazier v. Brown* (1861), 12 Ohio St. 294.

[151] *Cline v. American Aggregates Corp.*, 15 Ohio St. 3d 384 (Ohio) 474 N.C.2d 324, *aff'd*. *Cline v. American Aggregates Corp.*, 582 N.E.2d 1,7 (Ohio App. 10 Dist. 1989). An appeal from that decision was dismissed *Cline v. American Aggregates Corp.*, 550 N.E.2d 479 (OH 1990).

The Ohio Supreme Court broke with precedent and applied a "reasonable use" doctrine to underground water (Restatement of the Law 2d, Torts, Section 858):

> *(1) A proprietor of land or his grantee who withdraws ground water from the land and uses it for a beneficial purpose is not subject to liability for interference with the use of water by another, unless*
>
> *(a) the withdrawal of ground water unreasonably causes harm to a proprietor of neighboring land through lowering the water table or reducing artesian pressure,*
>
> *b) the withdrawal of ground water exceeds the proprietor's reasonable share of the annual supply or total store of ground water, or*
>
> *(c) the withdrawal of the ground water has a direct and substantial effect upon a watercourse of lake and unreasonably causes harm to a person entitled to the use of its water.*

The court ruled that the Restatement theory provides security that one's source of ground water cannot be usurped by a neighbor. A damaged property owner will be able to recover costs necessitated by the lowering of the water table. The party causing the harm will be liable for the damages. Ground water law has been profoundly affected by scientific advances and an understanding of hydrology.[152]

In *McNamera et al. v. City of Rittman, Hensley et al. v. City of Columbus et al*,[153] the Ohio Supreme Court was asked to determine the certified question:

> *Does an Ohio homeowner have a property interest in so much of the groundwater located beneath the land owner's property as is necessary to the use and enjoyment of the owner's home [para. 8]?*

The Supreme Court of Ohio answered the question affirmatively and ruled that,

> *Ohio [recognizes that] landowners have a property interest in the groundwater underlying their land and that governmental interference with that right can constitute an unconstitutional taking [para. 34].*

This case followed *Cline v. Am. Aggregates Corp.*,[154] a landmark court ruling protecting landowners' property rights in groundwater:

> *Through Cline, a property owner has a remedy against another property owner with land overlying a common aquifer, if the other landowner's use of the water unreasonably diminishes his water supply. Under Cline, a property owner's right to use the water underlying his property is not subject to a neighboring property owner's superior pumping system...[A] landowner's right to the water underlying his property is protected by law. A property owner has a potential cause of action against anyone who unreasonably interferes with his property right in groundwater. That cause of action arises only from the effect on the landowner's water rights -- no other effect on the overlying property is necessary for the cause of action to proceed.*

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[152] "Who Owns The Water?", *Water Systems Council*, updated August 2016. http://nationalaglawcenter.org/wp-content/uploads/2017/03/Who-Owns-the-Water-2016-Update-FINAL.pdf.

[153] *McNamara et al. v. City of Rittman*, [No. 2004-0357] and *Hensley et al. v. City of Columbus et al.*, [2004-0363], Ohio: Supreme Court 2005 https://scholar.google.com/scholar_case?case=15541018789172097O&hl=en&as_sdt=2006.

[154] *Cline v. Am. Aggregates Corp.* 15 Ohio App. 3d 384 (Ohio 1984), upheld on appeal, https://scholar.google.com/scholar_case?case=18039931694965782884&q=cline+v+american+aggregates+corporation+1989&hl=en&as_sdt=2006.

As pointed out in *Cline,* "a court's task is to make *whole* the damaged property owner":

> *Industries which utilize large amounts of underground waters will not be liable unless their use is unreasonable and creates a burden to neighboring landowners. Rural owners are also protected from commercial users who drastically lower the water table.*
>
> *Scientific knowledge in the field of hydrology has advanced in the past decade to the point that water tables and sources are more readily discoverable. This knowledge can establish the cause and effect relationship of the tapping of underground water to the existing water level. Thus, liability can now be fairly adjudicated with these advances which were sorely lacking when this court decided Frazier more than a century ago.*

## Neighbouring Wells Run Dry--Again

Homeowners residing near Hempt Bros. quarry in Monroe County, Pennsylvania, have had their wells go dry repeatedly over a period of decades, which has led to adverse impacts on the use of their properties and their quality of life. As reported in an April 6, 2017 article appearing in Pennlive Patriot Patriat-News, updated January 5, 2019,[155] its déjà vu for some Monroe and Silver Spring township residents:

> It was back in 2002 when 32 private wells in the area went dry. An investigation by the Department of Environmental Protection [DEP] traced the source of the problem to heavy water usage by a nearby mining company, the Hempt Bros.' Locust Point Quarry, which shares the aquifer.
>
> Since November [2016] resident along Kiner Boulevard, Old Stonehouse and Trindle Roads and other nearby properties report that area wells are once again going dry.
>
> Over the last few months, one by one, tanks full of non-potable water have been hauled in and hooked up to their homes—an emergency source of water while the homeowners wait, sometimes a month or more, for a new well to be dug deep enough to strike water from the depleting aquifer.
>
> Residents have worked to compile a list of approximately 30 neighbors whose wells have gone dry, and the number continues to grow. John Repetz, community relations coordinator for the Department of Environmental Protection, said that while the department has not received any direct complaints from property owners, it "has been made aware of 24 wells being impacted, and Hempt Bros. has already replaced or is scheduled to replace these wells….
>
> The aquifer these residents share with Hempt Bros. is a regional aquifer that encompasses the Conodoguinet and Yellow Breeches creek drainage basins….
>
> [T]he company—which has to pump water out of its way as it digs into the quarry—is allowed to discharge 12 million gallons of water per day. The DEP reports that the average pumping rate for 2016 was approximately 7.4 million gallons per day, and for the fourth quarter, the average was 5.3 million per day. The pumped water is discharged to an unnamed tributary to Hogestown Run….
>
> Kiner Boulevard resident John Underwood…has actively advocated for his neighbors, both now in 2002, and said he believes there should be a limit placed on how long homeowners must wait for a new well, and an emergency fee of $2,000 should be paid to the well owner within 48 hours to cover the cost of obtaining potable water and other related expenses. His wife…explained that Water Buffalo containers, once connected to a home, provide water flowing through residents' faucets. But the water is chlorinated and cant' be used for cooking, drinking, or laundry. Residents also incur higher electrical bills to run that temporary system.
>
> Underwood said he would also like to see stricter regulations placed on the mining operations. For example, when drought is declared, as it has been in the county since September, he believes Hempt Bros. should stop pumping from the quarry…."[W]e couldn't water flowers or wash cars, but

[155] https://www.pennlive.com/news/2017/04/when_is_it_going_to_happen_to.html.

> Hempt never had to stop." Repetz said Hempt Bros' pumping rate "is dependent on the groundwater infiltration rate into the quarry, and is not restricted under drought conditions."…
>
> The wells that have gone dry were fairly shallow, Hempt said. "The new ones are three to four times deeper than the ones we're replacing," he said….A drilling rig and jug-up yards or straw patches to show where the ground was recently disturbed, have been common sights in these communities, where those who are fortunate to have wells that still work worry that one day they too will turn on their faucets to find them dry. Resident Dean Nailor said his well went dry a week before Thanksgiving. His new well, when finally dug five weeks later, had to go down 550 feet to find water. His old well had been 130 feet deep. "It worked for 43 years," he said. "And then all of a sudden, there's nothing."
>
> Underwood said their next-door neighbors, in their 90s, had to wait for a new well for six weeks. Another neighbor, Larry Tuell, said the water started spurting from his faucets about two weeks ago. "I took a shower, then went into the kitchen to wash dishes, and it was just a trickle," he said. He's wait for a new well to be drilled.
>
> Jered Hock said his well was the first of the 30-plus wells that went dry around the end of 2001 and into 2002. That it was a wider-ranging problem didn't cross his mind. "I had no idea what was going on, other than it being an individual well failure," he said. Then he began hearing about neighbors' wells going dry….
>
> Monroe Township officials say they've been speaking with residents and Hempt Bros., and trying to provide information to affected well owners. But, said Supervisor Carl Kuhl, there's little the township can do, since Hempt Bros. is operating within the requirements of its permits.

Quarry blasting not only has the potential to cause domestic wells to go dry, but the wells themselves can be damaged. Quarry blasting also has the potential to cause domestic propane tanks to explode:

> *Significant research has been conducted into the effects of surface mine blasting on water wells. The impetus behind the research is the claims by domestic well owners that their wells were damaged by blasting in the vicinity of their wells. The authors themselves have received anecdotal accounts of damage to domestic wells by quarry blasting and the occasional home propane tank explosion in Ohio and oil exploration seismic shots in North Dakota, with little insight into what was experienced by the homeowner. Controlled, systematic observation of the phenomenon was needed but did not occur. No one wants to invest in it despite the benefits that could accrue [Section 2.10.2.2].*[156]

## *Origin of the Rule – Strict Liability*

The origin of the rule of strict liability stems from common law dating back to an 1868 case in England:[157]

> *Courts have often identified blasting (the controlled use of explosives to break down or remove rocks) as the paradigm of an abnormally dangerous activity because of its inherent dangers, and they applied strict liability in cases where blasting resulted in physical harm.* ***The victims of physical harm resulting from blasting were often totally innocent and uninvolved in the activity, while the persons conducting the blasting were doing so for their own financial***

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[156] Stuart a Smith and Allen E. Comeskey, *Sustainable Wells: Maintenance, Problem Prevention, and Rehabilitation*, 2010 (Boca Raton: Taylor and Francis Group, LLC).

[157] Legal Information Institute https://www.law.cornell.edu/wex/abnormally_dangerous_activity. See also "Torts—Blasting—Basis of Liability: Negligence, Trespass or Absolute Liability," *North Carolina Law Review* (Vol 40, No. 3, 4-1-1962): 640-647. http://scholarship.law.unc.edu/cgi/viewcontent.cgi?article=6006&context=nclr. See also Tim Wood, Sticks and Carrots: Rylands v Fletcher, CSR, and Accountability for Environmental Harm in Common Law Jurisdictions, 2013 91-2 *Canadian Bar Review* 275, 2013 CanLIIDocs 172, <http://www.canlii.org/t/28gr>, retrieved on 2020-01-16.

> ***benefit and were well-aware of the risks. Courts therefore took the position that defendants should be held strictly liable for any harm caused by projected debris.*** [emphasis added] *See Restatement (Third) of Torts § 20, cmt.(e) (2009).*
>
> *In Rylands v. Fletcher, an English case from 1868, the opinion read that "[a] person who for his own purposes brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril." American courts often cite this case as providing the origin of the rule on abnormally dangerous activities. In US jurisdictions, courts have never required that the activity take place on the defendant's land. However, they retained the requirement of "unnatural use" in the form of "not of common usage", meaning an activity that is unreasonable or inappropriate in light of the circumstances. See Restatement (Third) of Torts § 20, cmt.(d) (2009).*

## *Precautionary Principle*

In *Spraytech v. Hudson (Town)*,[158] the Supreme Court of Canada adopted the Precautionary Principle, as enunciated in the Bergen Ministerial Declaration on Sustainable Development (1990):

> *In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation [p. 31].*

The Supreme Court acknowledged that the Precautionary Principle has been included in virtually every adopted treaty and policy document related to the protection and preservation of the environment:

> *Scholars have documented the precautionary principle's inclusion "in virtually every recently adopted treaty and policy document related to the protection and preservation of the environment"*[159] *As a result, there may be "currently sufficient state practice to allow a good argument that the precautionary principle is a principle of customary international law."*[160] *The Supreme Court of India considers the precautionary principle to be "part of the Customary International Law"*[161] *In the context of the precautionary principle's tenets, the Town's concerns about pesticides fit well under their rubric of preventive action [para. 32].*

In *Sierra Club v. Strock* et al.,[162] the permitting agencies failed to comply with their own regulatory legislation, and ignored the tenets of the precautionary principle with devastating and irreversible consequences to the public after nine permits were issued to permit quarrying for limestone from wetlands. The United States District Court supplemented the Court's Order of March 22, 2006, which concluded that United States

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[158] *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (Town)*, [2001] 2 SCR 241, 2001 SCC 40 (CanLII), <http://canlii.ca/t/51zx>, retrieved on 2019-11-10.

[159] D. Freestone and E. Hey, "*Origins and Development of the Precautionary Principle*", in D. Freestone and E. Hey, eds., The Precautionary Principle and International Law (1996), at p. 41.

[160] J. Cameron and J. Abouchar, "*The Status of the Precautionary Principle in International Law*", in ibid., at p. 52). See also O. McIntyre and T. Mosedale, "The Precautionary Principle as a Norm of Customary International Law" (1997), 9 J. Env. L. 221, at p. 241 ("the precautionary principle has indeed crystallised into a norm of customary international law").

[161] *A.P. Pollution Control Board v. Nayudu*, 1999 S.O.L. Case No. 53, at para. 27. See also *Vellore Citizens Welfare Forum v. Union of India*, [1996] Supp. 5 S.C.R. 241.

[162] *Sierra Club v. Strock*, 495 F. Supp. 2d 1188 (2007), https://scholar.google.com/scholar_case?case=15371068605583740578&q=%22Florida+Rock%22&hl=en&scisbd=2&as_sdt=2006#[2].

Corps of Engineers, United States Fish and Wildlife Service, Vecellio and Grogan, Inc., Tarmac America LLC, Florida Rock Industries, Inc., Sawgrass Rock Quarry, Inc., Apac-Florida, Inc., Rinker Materials of Florida, Inc., and Kendall Properties and Investments had committed multiple violations of the Administrative Procedures Act (APA), the Endangered Species Act (ESA), the Clean Water Act (CWA), and the National Environmental Policy Act (NEPA).

> *The violations occurred in relation to the issuance of permits in April 2002 to nine private corporations for the destruction of approximately 5,400 acres of wetlands in order to remove the underlying limestone for processing into cement, concrete blocks, and other products.*
>
> ***The Court's Order granting summary judgment for Plaintiffs found that Defendants, the United States Army Corps of Engineers ("Corps") and United States Fish and Wildlife Service ("FWS"), had made numerous decisions lacking a rational basis and had failed to consider all relevant factors in their permitting decision; further, the Court found that the record in this case prior to issuance of the permits compelled the conclusion "that the permits should not have been issued."*** [emphasis added] *Sierra Club v. Flowers, 423 F.Supp.2d 1273, 1379 (S.D.Fla.2006).*
>
> ***Shockingly, the Court learned for the first time during the evidentiary hearing, in June 2006, that benzene, a carcinogen,[9] had been detected as early as January 2005 in the water being pumped from the Biscayne Aquifer ("Aquifer"), "the primary source of drinking water for the Miami — Dade County area." AR1028,[10] p. 4. The contamination was found in the area where limestone mining, which uses explosives[11] to remove the limestone from the Aquifer, is proceeding pursuant to the challenged permits. The contamination was so significant[12] that Miami — Dade County's Water and Sewer Department ("WASD") (the agency responsible for the delivery of drinking water for the County) shut down seven of the fifteen production wells which draw water from the Aquifer in that area, known as the Northwest Wellfield ("Wellfield"), and pump it to water treatment plants several miles away.[13] More than two years after the initial contamination incident,[14] Miami-Dade County's Department of Environmental Resources Management ("DERM"), the agency responsible for protecting the Wellfield, announced that it could not eliminate the mining-related blasting as a source of the benzene.[15] DERM's report concluded that the*** *1192*1192* ***two reported contamination periods (January 2005 to February 2006, and a second episode beginning in August 2006) were not caused by several other potential sources.***[16] [emphasis added]
>
> *Despite protestations to the contrary, it appears likely that the Corps-permitted mining activities, specifically the blasting used to dislodge the limestone[17] from the Aquifer, are a source of the benzene. A significant portion of the mining occurs in this same Wellfield where the contamination was discovered — some of the active mining operations are less than 3000 feet from the production wells. The Court need not determine conclusively[18] whether* *1193*1193* *the benzene originated from mining-related blasting as the contamination itself (and the Corps' failure to treat it as significant) is sufficient to expose the Corps' ongoing violations and dereliction of their duties under the CWA, NEPA, and APA.[19] When the Court questioned the Defendants' primary witness as to why the benzene contamination had not been included in the report of the Corps' "Three Year" review required by the permits,[20] his response was: "[W]e don't have any clear indication from the County that it's a problem." Tr. 2776 (John F. Studt).[21]*
>
> ***The Corps' shifting of responsibility to the County,[22] combined with a complete failure to advise not just this Court (during the pendency of these proceedings) but*** *1194*1194* ***also the public as to the contamination of the Wellfield by benzene and the potential connection to the mining activities,[23] eliminated the possibility of meaningful public participation required by NEPA and the CWA.[24] In summary, the Corps' lack of concern about the benzene contamination represents a failure to fulfill its legal obligations to conduct the agency's permitting activities with transparency.[25] This is just one example of the many errors made by the Corps in failing to provide accurate information for public assessment and review throughout the permitting process.***[26] [emphasis added]

*1195 Defendants' lack of transparency and clarity in the permitting process also have made the "public interest" issues[27] difficult to grasp in this case. It is impossible to discern precisely what is at issue under these permits with respect to the number of acres to be mined, the precise locations and types of mining impacts at any given point in time, and the total length of time during which the mining activities may proceed.[28]* ***Defendants rely on the permittees to report the number of acres mined and wetlands impacted, but the permittees use different descriptive terms than those used by the Defendants — raising a question as to whether there is or could be any meaningful monitoring to ensure the accuracy of the reporting of impacts***.[29] [**emphasis added**] *The Defendants offered very little[30] to support their untenable position that the alleged benefits to the economy outweigh risks of environmental harm from the continued mining.[31] Nor is it an easy task to test the Intervenors' arguments that there are insufficient 1196*1196 alternative sources of limestone to replace the rock being harvested under these permits, and that any reduction in mining will be devastating to the mining companies,[32] their employees, and the population in general.[33] Without an accurate baseline against which to measure the planned future mining impacts, and in light of the widely varying mining production levels of the different permittees, it is difficult to assess whether there might be alternative sources for some of the mining activities for at least some period of time.[34]*

*As noted in this Court's earlier Order, the Court's duty is to "immerse" itself in the evidence and determine whether the agency decision was rational and based on consideration of the appropriate factors.* ***The Court has endeavored to understand the full extent of the scientific evidence regarding the conditions of the Aquifer and its vulnerability to contamination.[35] From a review of the evidence, the Court has understood the primary message to be essentially undisputed:[36] the deep, vast quarry pits left behind from the mining 1197*1197 activity expose the Aquifer (and the drinking water drawn therefrom by the pumps in the Wellfield) to a greater risk of contamination than if the pits were not present.[37] Regardless of whether the existing or planned municipal water treatment facilities will be able to treat those incidents of benzene contamination which already have occurred, or any potential future contamination by benzene or pathogens such as cryptosporidium or giardia, it nevertheless remains an exceedingly significant occurrence that a previously pristine Aquifer has suffered these grave problems***. [emphasis added] *The Court finds that the evidence clearly establishes that the CWA and ESA compel denial of these mining permits, and also that the Corps' governing regulations, as well as the intent and letter of NEPA and the APA have been violated by the Corps' issuance of these permits.[38] The principles governing judicial review of agency actions direct that the Court approve an agency decision even if the Court disagrees with the agency,[39] as long as the agency's conduct is compliant with the law, i.e., is not "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law, or without observance of procedure required by law." 5 U.S.C. § 706(2)(A).[40] 1198*1198 However, "[t]he failure of an agency to comply with its own regulations constitutes arbitrary and capricious conduct," Simmons v. Block, 782 F.2d 1545, 1550 (11th Cir.1986),[41] and subjects the agency action to reversal according to the APA. 5 U.S.C. § 706(2)(a).*

***In three decades of federal judicial service, this Court has never seen a federal agency respond so indifferently to clear evidence of significant environmental risks related to the agency's proposed action.[52] It may be that the power of "economics" 1201*1201 (i.e. financial profit to be gained from further production of building materials) unduly influenced the Corps***. *The events preceding the issuance of the EIS and the Record of Decision ("ROD"), specifically when the Corps seemed to wilt in the presence of pressure for approval of the permits, suggest such a conclusion. 423 F.Supp.2d at 1287-88.[53] It now appears that even the local governmental agencies have yielded, perhaps as a result of increasing pressure from the mining companies or others.[54] Recently, the County restarted some of the production wells which had been shut down more than two years ago due to benzene-related contamination issues.[55] CAP, p. 5. Under the presumption that benzene will continue to be found, the County appears to have conceded that upgrades to the water treatment plant which handles the majority of the County's drinking water are necessary[56] in order to prepare for the perhaps inevitable reclassification of the Wellfield 1202*1202 from "groundwater" to "groundwater under the direct influence of surface water" ("GWUDI")[57] by federal and state authorities. Even if the water treatment plants are able to treat the raw water for the anticipated amounts of benzene, it is nevertheless of grave concern that*

> *benzene will now regularly affect a previously pristine Aquifer.*[58] ***The ability to cure a problem does not justify its creation. It is improper for these risks to be imposed solely on the public, including the risk that the public will have to pay a substantial sum to upgrade the water treatment facilities, particularly when the private sector earns enviable profits on the harvesting of these non-renewable natural resources***. [emphasis added]

According to the Interdepartmental Liaison Group on Risk Assessment (ILGRA) of the United Kingdom,[163] the precautionary principle was originally framed in the context of preventing environmental harm, but is now widely accepted as applying more broadly to include the threat of harm to human, animal or plant health. The precautionary principle is forward looking and applied proactively:

> *The purpose of the Precautionary Principle is to create an impetus to take a decision notwithstanding scientific uncertainty about the nature and extent of the risk, i.e. to avoid 'paralysis by analysis' by removing excuses for inaction on the grounds of scientific uncertainty [p. 6].*
>
> *The precautionary principle should be invoked when:*
>
> *i. there is good reason, based on empirical evidence or plausible causal hypothesis, to believe that harmful effects might occur, even if the likelihood of harm is remote; and*
> *ii. a scientific evaluation of the consequences and likelihoods reveals such uncertainty that it is impossible to assess the risk with sufficient confidence to inform decision-making.*
>
> *The Precautionary Principle:*
>
> - *is narrower than 'being cautionary'; and*
> - *is not relevant unless scientific uncertainty is a significant factor and there is good reason to expect harmful effects.*

A lack of scientific certainty in addressing potential non-trivial adverse environmental (and potentially catastrophic) impacts and the threat of harm to human, animal and plant life is not a reasonable basis for issuing an aggregate licence (or permit) to permit a quarry operation.

## *HOLDING ENVIRONMENTAL CONSULTANTS ACCOUNTABLE*

Results of an investigation that appeared in the June 21, 2019 issue of Canada's National Observer[164] describe how Canada used dubious research to approve major industrial projects. Consultants conducting environmental assessments were often pressured by their own company or clients to downplay environmental concerns, and avoid use of the word "significant."

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163 The Precautionary Principle: Policy and Application, https://www.hse.gov.uk/aboutus/meetings/committees/ilgra/pppa.pdf.

164. Holly Lake, "Insiders reveal how Canada used dubious research to approve major industrial projects," https://www.nationalobserver.com/2019/06/21/investigations/insiders-reveal-how-canada-used-dubious-research-approve-major-industrial. *The investigation is part of a special National Observer report about oversight of regulated industries, in collaboration with the Corporate Mapping Project — a research and public engagement initiative, jointly led by the University of Victoria, Canadian Centre for Policy Alternatives and the Parkland Institute, and supported by the Social Science and Humanities Research Council of Canada.*

***In the world of environmental assessments, few words carry as much significance as "significant."***[165] [emphasis added]

*Simon Halfyard* knows that better than most. A biologist who works as an environmental consultant in British Columbia, he works for a company that was hired by a sub-consulting firm to do an assessment of the risks and impacts associated with a large-scale natural gas project on the province's north coast, which was going to consume hectares of land. (He asked that his real name not be used for fear of reprisal.)*

*It became clear to him that a large amount of critical fish habitat was going to be lost to the footprint of the project.*

*"So in my interpretation of this, I declared this particular project to be a 'significant' risk," he says. "You want to try and avoid significant effects."*

*His assessment wasn't well-received by his manager, who made it clear he was going to have to tone down his language and focus on the minimum requirements — to strive, Halfyard says, "for mediocrity."*

*"'You can't say significant,'" Halfyard recalls being told by his manager. "'You're putting the project at risk.'"*

*The pressure persisted — from his own company, as well as the company that had sub-contracted them. Statements were removed from his report, and he was called out by the project manager as uncooperative in abrasive emails to his employer.*

*"I had two levels of censorship," he says. "I didn't understand why I should be unfairly pressured to undermine my professional judgment."*

*Halfyard is one of several scientists who spoke to National Observer about their experiences with environmental assessments on major industrial projects that got approved after their proponents submitted dubious evidence in their applications. The consultants all experienced similar pressure to overlook evidence that might make it difficult for projects to get approved by regulatory agencies….*

*In the middle of his own experience, Halfyard's manager told him he was a "brilliant biologist" during a performance review.*

*He responded by asking why then was he being told to break the law by not reflecting his findings in his assessment. He's a member of British Columbia's College of Applied Biology — the first of its kind in North America. It was created by the provincial legislature in 2002 to regulate the professional conduct and competency of its members.*

*"My ethics are legislated under provincial law," Halfyard says. "Our requirement is to uphold the interests of the public and the goals of environmental stewardship."*

*Just over a week after putting the question of breaking the law on the table, he says he was called into the same office again and fired.*

*"I was challenged and ultimately lost my job because I was not cooperative. I was a liability for upholding my professional accountability."*

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[165] Section 4(b) of *CEAA 2012* with respect to the "Precautionary Principle" requires that assessments of proposed projects "…are considered in a careful and precautionary manner to avoid significant adverse environmental effects." [emphasis added] Section 19(1)(d) of the *CEAA 2012* indicates that the environmental assessment must take into account "mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project" (emphasis added).[para. 107] In *Taseko Mines Limited v. Canada (Environment)*, 2017 FC 1099 (CanLII), the Federal Court upheld the Review Panel's decision in which it did not agree that Taseko's proposed mitigation measures were feasible or that they could mitigate the significant adverse effects of the project *with respect to water seepage and impact on water quality in Fish Lake (Teztan Biny) and the surrounding area [para. 1].* <http://canlii.ca/t/hp4hn>, retrieved on 2019-12-31.

*The project was not given the declaration of "significance" in the assessment. Halfyard doesn't understand the resistance he faced, given that projects with that declaration can still go ahead.*

## ***Pressure to do things or say things that I didn't think were true***

*While Halfyard was operating under the provincial environmental assessment regime in British Columbia, Tom Manning* says the experience is no different under the federal regime.*

*A fisheries biologist who specializes in fish habitat, he started doing environmental assessments in the mid-1990s, but no longer does them in Canada.*

*He no longer does assessments for project proponents as he "felt that pressure to do things or say things that I didn't think were true based on the science that I knew."*

*His biggest issue with how things are handled in this country is that proponents hire environmental consulting firms, whose scientists assess a project's impact as part of the process of getting the green light from regulators to move ahead.*

*"There's an inherent conflict of interest there because the people paying the bills expect you to be able to permit a project. There are times when the science will tell you this is not a good project and it's going to be damaging to the environment, to wildlife, fish or birds. And there (will) be pressure on you to go ahead and (recommend something that would allow regulators to) permit it anyway because the proponent, the developer, is paying you to do that," Manning says.*

*In the United States, when a proponent applies for a project permit, the environmental impact assessment is done by a third party hired by the Environmental Protection Agency, so there is more independence from the project proponent.*

*"That's the way it's done everywhere else in the world," he says. "(In Canada), there isn't that independence."*

*That means junior scientists who discover risks are told not to include damaging findings in their reports. Sometimes the project is simply taken from them. More senior scientists will probably be permitted to write what they've found in their report, but it just won't be released, says Manning, who says he's had horrified looks from his bosses, insisting, 'You can't say that!'*

*"Then I'm like, 'Well, that's what the analysis shows, so that's what's going in my report,'" he says.*

*"They'll pay your consulting fee, take your report and it'll just get thrown in a bin somewhere and you won't get a job with them again. If you speak up too much against the project, you'll probably just get fired."*

*These days, Manning works independently and only does environmental assessments for NGOs, governments or community groups.*

*"I don't generally do them for developers because they use too much bias and pressure when I come up with a certain answer."*

## ***Recommendations for independence***

*In August 2016, ahead of introducing Bill C-69, McKenna established an expert panel to review federal environmental assessment processes.*

*Among its recommendations was taking the hiring of consultants who conduct assessments away from proponents and instead have the government create an independent agency that would select them.*

*"That was rejected by the government," says Martin Olszynski, an associate law professor at the University of Calgary.*

*"So there is nothing in the act that addresses it directly."*

*Justina Ray, president and senior scientist at the Wildlife Conservation Society Canada, isn't convinced the third-party route solves the problem, as governments will often hire the same consultants and sink into the same traps. While the process might be different, much depends on culture and the capacity to steward things properly, she says.*

*“Agencies can also get captured by industry. I’ve seen it time and again.”*

*For her, the key is a robust review process that holds proponents and consultants accountable for assessments and enhances transparency.*

*“If your work undergoes a rigorous review, you’re going to aspire to do a better job next time. I think many of these processes get away with relatively weak reviews, so that permits them to follow a formula, if you will, on these assessments, where they don’t get challenged sufficiently.”*

*Earlier this year, a study by Adam Ford, a professor of biology at the University of British Columbia, found that companies in the oilsands were using inconsistent scientific methods in their own assessments, and rarely subjecting their work to independent verification.*

*Ford, who grew up in Calgary, looked at 30 different oilsands assessments conducted between 2004 and 2017 as part of his research.*

*In an interview, he told* National Observer *that his research found that companies were using different ways to measure wildlife habitat in their assessments. The research also found that the oilsands companies who actually got their work reviewed independently had less confidence about being able to mitigate damage caused by their projects.*

*"It would be far more efficient as a whole if they co-ordinated on how to do the science," he said. "That would make everybody’s job so much easier. It would be much easier to review the projects."*

*Instead, he said that companies are all using different models, which he said makes no sense from either a scientific or economic standpoint.*

*"It’s inefficient for the industry and I think it makes for questionable assessment."*

## ***Looking for birds when they're not around***

*In 2008, Matt Farrell*, a wildlife ecologist, was hired to do an environmental assessment for a company in the Alberta oilsands that was looking to expand an extraction site.*

*The focus was on a threatened species of birds in the boreal forest, and the prime window for finding them ranged from the middle of May to the middle of July. It was up to the proponent who’d hired him to decide when the surveys occurred, and he was brought in to do the first one on July 8.*

*“When you go out to do wildlife surveys, you’re interested in knowing whether the wildlife is there or not. And it just seemed to me like maybe they didn’t want to know,” he says.*

*“We didn’t detect any on the surveys we did, but I would be very hesitant to say that there are no birds there of that species because I don’t think that we surveyed for them properly.”*

*Of his first survey on July 8, Farrell says: “If you wanted to actually survey for it properly you'd have to be surveying before then."*

*But even if the birds were there, he and his team wouldn’t have detected them because the birds were unlikely to be singing or responding to the playbacks they were using that far into the breeding season.*

*“I don't know if that was intentional or not, or if it was sort of a rush thing where they just needed somebody to be out there as soon as possible. On paper, everything that (the proponent) did was legitimate and sort of met the rules that are required. But in my mind, it was sort of the minimum required. It could've been done a lot better.”*

*In his report, Farrell recommended surveying again the following year from the mid-May to mid-July.*

*“I don’t remember hearing back from them about the recommendations in this one,” he says.*

## ***The science in Canadian assessments 'sucks'***

*Generally speaking, Olszynski says, the science in Canadian environmental assessments “sucks.”*

*When Bill C-69 was before the House Standing Committee on Environment and Sustainable Development, an amendment by Green Party Leader Elizabeth May was adopted to add a duty for*

*all actors on the government side — scientists, panels and agencies — to act in a manner that "adheres to the principles of scientific integrity, honesty, objectivity, thoroughness and accuracy."*

*"It really should have applied to proponent scientists as well," says Olszynski, who appeared before the expert panel, commented on its terms of reference and was commissioned by it to write policy briefs. He also appeared before the House and Senate committees studying the bill.*

*"But I think it's still an improvement."*

*As for the current state of things, he's clear that he doesn't think consultants are bad people.*

*"I think they're in a dynamic here that's very difficult to undo. My hope is that by recognizing that their work will be subject to scrutiny by people who are subject to that kind of duty, it will exert a downward pressure on proponents. And consultants will have something to push back with against proponents."*

*The language in May's amendment is borrowed from the United States, where the duty of scientific integrity has existed as part of the process for 30 years. But in Canada, Olszynski notes, the courts have taken a laid-back approach to assessments, not wanting to wade into the science, and instead deferring to government reports that are built on proponent reports.*

*"All of that has created a perception in the consulting community — or at least among the lawyers working for proponents, who are then leaning heavily on those consultants — that they don't need to do much work here. It doesn't have to be robust or rigorous because no one is going to touch it with a 10-foot pole."*

*Olszynski compares the situation to one in which lawyers for a company that is being audited advise the auditors about what's appropriate.*

*"That just doesn't work, yet we have this reality where we know proponent lawyers are advising consultants. That's not addressed by (Bill C-69)."*

*While there was a push during consultations and hearings to force more data-sharing and install a more rigorous approach to data review, it didn't get translated into the bill — despite a recommendation from the expert panel.*

*"We've been told there will be a policy essentially of open data, but time will tell," Olszynski says.*

*While the existing Canadian Environmental Assessment Registry allows access to some information, including proponents' environmental impact statements, the underlying data is missing most of the time.*

*"It makes it hard to scrutinize the conclusions if you don't have the underlying data," Olszynski says.*

*So, he wonders, why not open this up to what's called sunshine enforcement?*

*"The reality is that it's hard for the regulator. They can't scrutinize everything the proponents submit to them, but if you put it on a public registry that's easily accessible, and enlist the public and academics and researchers in your efforts, we are then diving into that data because we want that for our own purposes. So we can then identify issues with compliance or non-conformity."*

*The levels of rigour and transparency are no different after the assessment phase. There are always terms and conditions under the Environmental Assessment Act that require monitoring reports and follow-up reports, which Olszynski says are very hard to get your hands on.*

*"As it currently stands, you very often have to file an ATIP (Access to Information and Privacy request) to get that information. That just isn't the way it's supposed to be. A lot people feel strongly it should be made public."*

*He's done his own research showing that while proponents commit to adaptive management during the assessment process, they never follow through and actually do it.*

*"That's why we're left with tailings ponds and this idea that we really don't know how to remediate them."*

*And in some cases, mitigation commitments are made with no data to back up their effectiveness.*

***Industry will figure it out***

*Petr Komers, who has been running his own Calgary-based environmental consulting company for nearly 20 years, says the scientific community is somewhat hopeful that the science and the rigour of the review process will improve under C-69 — but the scientists are not holding their breath.*

*"It's nice to talk about scientific integrity, but at the end of the day if it's all you do, that can be in the eye of the beholder," he says. "We need stronger language, something more concrete. What statistics? What analysis? Over what period of time? What geographic area? I've been battling with regulators for decades now saying you need to be more descriptive, but they rebut it."*

*Komers, also a co-author on the recent study of oilsands project assessments that was led by Ford, recounts a conversation he had with a former director of the Alberta Energy Regulator (AER), who was adamant they didn't want — or need — to be prescriptive.*

*"'We believe the industry and engineers will figure it out,'" Komers recalls him saying.*

*"That's the reality on the ground."*

*Just a year ago, he testified at a hearing before the AER on behalf of the Fort McKay First Nation. The community was opposed to a pilot project by Prosper Petroleum Ltd. in the Moose Lake Management Area and the impact it might have on vegetation, water and wildlife — specifically caribou and moose.*

*It was considered a pilot project because it would pump out less than 12,000 barrels of oil a day, which meant it only required the lowest level of impact assessment, known as a screening.*

*"I'm even coy in saying that, as it implies a proper study," Komers says, noting a screening can be done from a computer at a desk.*

*Appearing before the AER on behalf of the First Nations community, Komers pressed the proponent about its assessment report and whether any wildlife surveys had been done as part of it. The proponent said they hadn't done any and were relying on data gleaned from existing literature and other surveys.*

*In contrast, as part of their population viability analysis of moose and caribou in the area, Komers and his team had used vegetation data, mostly based on remote sensing, to quantify the availability of habitat, and old satellite images of the area to show how it's changed over the past two decades.*

*"We can exactly calculate how the vegetation on the land is changing. We have data we gathered ourselves," he says. "There is a negative trajectory of habitat for moose and caribou and other old growth species — it's declining, there's no two ways about it."*

*Komers says the Fort McKay First Nation is "quite business-savvy and not against the oilsands, per se." In fact the community has existing agreements with industry. But residents were already seeing the impact of development on the conservation area — and they wanted to reverse those effects, not add to them, to ensure they still had a safe place for their traditional land use.*

*"Here, they drew a line in the sand," he says, noting it was clear the impact on the area wasn't going to be reversed by adding another project to the mix.*

*The proponent said it had a mitigation plan in place that would reverse the project's impact, something Komers pressed them on, as no one on the proponent side had gone into the field, nor did they present any scientific, peer-reviewed literature to support their claims.*

*"They just don't have the data that would tell you whether, or to what degree, a certain mitigation measure is successful," he says. "And yet, in the hearings and in their submission, they claimed that their project will not have any such effects.*

*"The regulators accepted their claims, saying that, 'Yeah, the proponent has mitigations in place and so the environment will be sufficiently protected.' Our whole point was there is no data supporting those claims. They dismissed our evidence in favour of accepting the unsubstantiated, undocumented claims by the proponent."*

*What's more, the proponent tried to show Komers' findings overstated the project's impact.*

*"It was very odd," he says. "The decision by the AER rebutted all of our calculations of vegetation disturbance and wildlife population declines. If we're wrong, we're wrong. That's the scientific process: if they have better analysis and data and show we did our calculations wrong. But they simply stated that we overestimated the effects and the proponent has limitation measures in place.*

*"It was very blatantly a biased assessment that the panel decided to disregard our numerical, data-driven evidence, but accepted the verbal claims without any scientific underpinning."*

*The Fort McKay First Nation has appealed the decision, and it's now before the courts.*

*Komers says this is a case where "even with the Canadian Environmental Assessment Act changing, it wouldn't have an effect."*

*Under current law, proponents are required to measure the effectiveness of mitigation and bring data to demonstrate that their efforts have worked.*

*"To this day, that's extremely rare," he says. "You can't measure anywhere in the oilsands where this condition on an approval has been complied with — not for wildlife or vegetation ecology."*

*Once a forest and land cover has been disturbed, especially if that includes the soil, Komers says it's very hard to return it to how it was before. While a proponent can put in some soil and plants, the best that can be accomplished is the creation of what's known as a novel ecosystem.*

*"I can confidently say that in terrestrial ecology we are not aware of any example, despite us asking, were you can say a pre-disturbance condition has been achieved."*

*He says that in areas where there were once 150 to 200 species of vegetation, after reclamation there are maybe 15 or 20.*

*"You have about 10 per cent of the diversity," Komers says. "To a layperson in the oilsands, you can see a reclaimed forest and think it looks OK. To an ecologist, it looks poor."*

*He recalls one time walking through a reclaimed forest with a group of elders. They repeatedly commented on how quiet it was, as there were no birds.*

*"You hope the wildlife comes back, but what you end up with is an ecosystem composed of different species, usually fewer species. They're usually more tolerant of human activity — white-tailed deer, coyotes, magpies — as opposed to the wolves and cougars, which are old-growth species."*

## ***Failure to address transparency, cumulative impacts***

*If passed, the new federal environmental-assessment regime will stay in line with the changes made by the Conservative government in 2012 and only apply to major projects, leaving thousands of other proposed projects in Canada to fall under provincial regimes. Olszynski says the recent project list put out by the federal government is the same as the current one — and in some cases actually weaker in the sense that it raises the threshold. For instance, it will capture fewer mining projects than the current regime does.*

*That's not great news from a transparency perspective, as some provincial acts, including in Ontario, don't require that the identity of those reviewing assessments be disclosed.*

*"It doesn't make those reviews transparent to the public or interested parties, but (proponents) will respond to the reviewers. That often leaves them in a cherry-picking situation whereby they are taking only certain points and addressing them in their responses, even though the reviewers had been much more detailed and perhaps critical," says Ray of Wildlife Conservation Society Canada.*

*Currently, she says, it's difficult to see what concerns were raised in the course of a review or how they were addressed, if at all. Even when she knows there have been a large number of letters submitted to the regulator outlining significant concerns and issues, "none of those see the light of day."*

*"That really has to improve, and I don't know how this regime will improve that because it's a lot about capacity and culture of the agency," Ray says.*

*"The agency needs to be able to disclose the reasons for its decision. That has happened to a limited extent in Bill C-69."*

*For her, the biggest hole in the legislation is its failure to address the cumulative effects of projects. In her view, the focus of assessments is still far too narrow and doesn't look at the big picture beyond the effects of the project at hand, to account for past and future ones. Effects can be additive, with the impacts of multiple projects on top of one another, or the project itself may contribute to or aggravate cumulative effects. That can happen by inducing growth by bringing in a road that allows other projects to come into the same area.*

*"When a project starts, it's already starting with a legacy of impact. It has to take that into account into its baseline conditions much better than it does right now," Ray says.*

*Komers says the cumulative effects of projects in Alberta, where countless projects undergo screenings rather than a full environmental impact assessment, is "huge," and well-documented in peer-reviewed literature and government reports.*

*"The caribou have been declared as non-sustainable in Alberta (as a result of habitat loss), and that's Environment Canada saying that, not me."*

*Provisions calling for a broader regional approach have been part of the law since the 1990s, but it's usually individual project assessments that get burdened with gauging the broader implications, so they've been only dealt with in a limited fashion to date. Bill C-69 isn't going to improve that.*

*While the legislation mentions and enables regional assessments, which are the only place cumulative effects can be seriously studied, Ray says even those provisions are "weak."*

*"There are no instructions or anything about the conditions where they really should be triggered. You could and should develop those in regulations, but that hasn't occurred yet," she says. "Many of us are disappointed. You can imagine a scenario where it might never happen unless there's some key triggers."*

*Her concern is compounded by the fact that plenty of projects in Ontario won't ever trigger the federal framework, leaving them to be assessed under the provincial act, which doesn't even mention cumulative effects or regional assessments.*

*By not looking at the bigger picture, "We're missing the forest for the trees," Ray says.*

* Names have been changed to protect the identity of sources

Consultants can be held accountable to third-parties for acts of negligence in the performance of their professional duties and obligations. As to the level of competence and due diligence required of a consultant, it will depend on the nature of the alleged *tort* and often engage the standards of profession practice and duty of care associated with the particular profession. A third-party that has sustained injury to property or health from operation of a quarry, established (permitted) on the recommendations or findings of applicant-retained consultants, could launch an action if there is sufficient evidence to support a causal connection between the alleged injury and the applicant-retained consultant (e.g. negligent misrepresentation, a failure to address, warn or inform others of potential damage to property or harm to persons as a consequence of blasting, dewatering, equipment usage, etc.). It must also be proven that the applicant-retained consultant owes a legal duty to the third party. Before considering pursuing an action against an applicant-retained consultant, legal advice should be sought. A number of third-party claims against environmental consultants have been filed, examples of which are as follows:[166]

[166] Joel Schneider, *The Expanding Liability of Environmental Consultants to Third Parties*, 13 Vill. Envtl. L.J. 235 (2002). Available at: https://digitalcommons.law.villanova.edu/elj/vol13/iss2/2.

- A consultant was sued by an assignee of its contract for failing to identify hazardous waste contamination in an assessment report.[167]
- After its business collapsed, a neighbor to GE's contaminated property sued GE's consultant for negligently per-forming a site investigation.[168]
- A group of individuals "residing near" the Rocky Mountain Arsenal sued the government and Shell Oil Company for "personal injury and property damage as a result of airborne pollutants released during the joint cleanup effort at the Arsenal by Shell and the Government.[169]
- A consultant whose contract was with Washington Metropolitan Area Transit Authority was sued by a heavy equipment operator who contracted silicosis while mucking in a tunnel under construction as part of the subway system.[170]
- A consultant for a cantaloupe grower who conducted a food safety audit at a cantaloupe packing facility (but who was not retained to test cantaloupes) was sued after a listeria outbreak killed 33 people and made 147 people sick.[171]

## *POTENTIAL ADVERSE IMPACTS OF RESIDING NEAR A BLASTING QUARRY OPERATION*

If you reside near a blasting quarry operation, you and your family can expect to be impacted in a number of ways, both financially and in your quality of life:

- <u>If you are struck by errant flyrock you can be injured or killed</u>.
- Flyrock can damage your home and personal property.
- Noise, dust, fumes, odours and other pollutants and contaminants generated by the quarry will have negative impacts on your health and the enjoyment and use of your property (indoors and outdoors).

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[167] *Bronstein v. GZA Geoenvironmental, Inc.*, 665 A.2d 369 (N.H. 1995) (finding no tort liability because consultant owed no duty of care to ultimate purchasers of property).

[168] *Midwest Aluminum Mfg. Co. v. General Elec. Co.*, No. 4:90-CV-143, 1993 WL 725569, (W.D. Mich. 1993) (granting consultant's motion for summary judgment and holding consultant lacked "requisite relationship" with neighbor sufficient to create any legal obligation).

[169] *Daigle v. Shell Oil Co*., 972 F.2d 1527, 1530 (10th Cir. 1992). The plaintiffs sought "response costs" from Shell and the government for medical monitoring under § 107(a) of the Comprehensive Environmental Response, Compensation and Liability Act [hereinafter CERCLA] as well as damages from Shell under an "ultrahazardous activity" strict liability claim. The Court of Appeals for the Tenth Circuit granted the government's motion to dismiss all of the tort claims against it for lack of subject matter jurisdiction insofar as the cleanup activities fell under the discretionary function exception to their waiver of sovereign immunity. As to Shell's motions to dismiss, the court dismissed the CERCLA § 107(a) "response cost" claims, while denying dismissal of the "ultrahazardous activity" strict liability claim.

[170] *Caldwell v. Bechtel, Inc.*, 631 F.2d 989 (D.C. Cir. 1980). The Court of Appeals for the District of Columbia Circuit ruled that Bechtel owed Caldwell a duty of due care to take reasonable steps to protect him from the foreseeable risk of harm to his health posed by the excessive concentration of silica dust in the Metro tunnels.

[171] *Lopez v. Frontera Produce*, 13CV31951. The District Court of Colorado ruled that the consultant should have known that the audit would be used to identify conditions that led to the distribution or the contaminated cantaloupe. *"Risk Management for Environmental Consultants,"* Bloomberg Environment, June 12, 2015. https://news.bloombergenvironment.com/environment-and-energy/risk-management-for-environmental-consultants.

- Vibration[172] and airblast[173] from blasting can damage your home, and cause health issues and psychological distress.
- Blasting below the water table can impact aquifers and cause your well to become polluted, contaminated or to go dry.
- Without a permanent or stable supply of potable water you are not going to be able to obtain mortgage financing on favourable terms and conditions, and selling your home may not be possible or, in order to sell your home, you will have to sustain a huge financial loss.

A quarry owner (including its environmental consultants) can be held liable for these types of detrimental impacts, as can a municipality or township that knowingly allows its residents to be subjected to these types of detrimental impacts.[174] It is beyond the power of a county or municipality to authorize maintenance of a nuisance.[175]

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[172] See *Crouch v. North Alabama Sand & Gravel, LLC, and Austin Powder Company*, 177 So. 3d 200 (Ala. 2015). The appeals court held that disputes of material fact warranted submission to a jury on landowners' claims for *wantonness, nuisance* and *damages* caused by the conduct of an abnormally dangerous activity (i.e., quarry blasting). Blasting occurred about once a month at the quarry. According to the Crouches, the blasting caused strong vibrations/tremors in the ground that caused extensive damage to their home and possessions. Repeated complaints to the quarry operator were ignored. As for the Crouches' claim for damages caused by the conduct of an abnormally dangerous activity, the appeals court held that expert testimony was not required in order to establish that the blasting operation was "abnormally dangerous" for the purpose of strict liability. According to the affidavit of the son, a contractor, the blasting started about 10 years ago, and caused significant damage to his parents' house, and that as recently as the summer of 2013 he was retained to do major renovations to the house. The main reason for having the renovations done was "because the shaking of the house from the blasts had caused water to leak into the house. The basement had become infiltrated with black mold, which was aggravating my Dad's [chronic obstructive pulmonary disease], as well as making my Mom sick too. They spent about $50,000 on the renovations, and it would have cost more if I had not been providing them with a family discount of sorts [para. 206]." https://scholar.google.ca/scholar_case?case=4918835222144993731&q=crouch+v+north+alabama+sand+%26+gravel+llc&hl=en&as_sdt=2006.

[173] Monia Aloui, Yannick Bleuzen, Elhoucine Essefi and Chedly Abbes, "Ground Vibrations and Air Blast Effects Induced by Blasting in Open Pit Mines: Case of Metlaoui Mining Basin, Southwestern Tunisia," *Journal of Geology & Geophysics*, (Volume 5 Issue 3, 2016): 1-8. "Air blast can be affected considerably by surface winds and climatic conditions such as temperature inversions (increase of temperature with altitude). Under these conditions, the peak over pressure can increase by a factor of 5-10, requiring therefore the adoption of certain precautions. Indeed, high air blast over pressure could case structural damage, while, those produced by routine blasting operations under normal atmospheric conditions are not likely to do so [p. 3]." https://www.longdom.org/open-access/ground-vibrations-and-air-blast-effects-induced-by-blasting-in-open-pit-mines-case-of-metlaoui-mining-basin-southwestern-tunisia-2381-8719-1000247.pdf. Ground *vibrations* enter the structure (house) through the basement and *airblast* enters the house through the walls and roof. Airblast arrives at off-site structures (houses) later than do ground vibrations, causing a homeowner to think that two separate blasts occurred. (Blaster Training Module for use by the Sheridan District Office, Wyoming Department of Environmental Quality, Land Quality Division.)

[174] As a general rule, if you are injured due to the negligence of another person or entity, you have the right to file a claim for compensation against that party. If the entity you wish to sue is a city or municipality in Ontario, the claim is controlled by the Ontario Municipal Act. You should always seek legal advice before taking any legal action.

[175] *Barnes v. Quarries Inc.*, 204 Va. 414 (Va. 1963) 132 S.E.2d 395, file:///C:/Users/Windows%207%20PC/Downloads/Barnes%20v.%20Quarries,%20Inc%20(2).pdf.

In terms of land use planning and development, municipalities and cities in Ontario must adhere to the Provincial Policy Statement. The new 2020 Provincial Policy Statement, effective May 1, 2020, in part, states:

> *It is equally important to protect the overall health and safety of the population, including preparing for the impacts of a changing climate. The Provincial Policy Statement directs development away from areas of natural and human made hazards. This preventive approach supports provincial and municipal financial well-being over the long term, protects public health and safety, and minimizes cost, risk and social disruption*
>
> *Taking action to conserve land and resources avoids the need for costly remedial measures to correct problems and supports economic and environmental principles.*
>
> *Strong communities, a clean and healthy environment and a strong economy are inextricably linked. Long-term prosperity, human and environmental health and social well-being should take precedence over short-term considerations.*
>
> *The fundamental principles set out in the Provincial Policy Statement apply throughout Ontario. To support our collective well-being, now and in the future, all land use must be well managed.*
>
> > ***Policy 1.1.1c:*** *Healthy, liveable and safe communities are sustained by avoiding development and land use patterns which may cause environmental or public health concerns.*
> >
> > ***Policy 1.1.1d:*** *Healthy, liveable and safe communities are sustained by avoiding development and land use patterns that would prevent the efficient expansion of settlement areas*[176] *in those areas which are adjacent or close to settlement areas.*
> >
> > ***Policy 1.1.3.1:*** *Settlement areas shall be the focus of growth and development.*
> >
> > ***Policy 1.1.3.2a:*** *Land use patterns within settlement areas shall be based on densities and a mix of land uses which efficiently use land and resources.*
> >
> > ***Policy 1.1.3.2c:*** *Land use patterns within settlement areas shall be based on densities and a mix of land uses which minimize negative impacts to air quality and climate change, and promote energy efficiency.*
> >
> > ***Policy 1.1.2.2d:*** *Land use patterns within settlement areas shall be based on densities and a mix of land uses which prepare for the impacts of a changing climate.*
> >
> > *Land use patterns within settlement areas shall also be based on a range of uses and opportunities for intensification and redevelopment in accordance with the criteria in policy 1.1.3.3, where this can be accommodated.*

**Note:** If you reside near a blasting quarry operation, please take the online survey "Proximity to Blasting Quarry Operations" at https://intval.com/survey/.

[176] Section 1.1.3 "Settlement areas are urban and rural settlement areas, and include cities, towns, villages and hamlets. Ontario's settlement areas vary significantly in terms of size, density, population, economic activity, diversity and intensity of land uses, service levels and types of infrastructure available.

## *CONCLUSIONS & OBSERVATIONS*

1) The Ontario government and the municipalities under their jurisdiction have a moral responsibility and legal duty to protect its citizens and the environment from the potentially lethal consequences of flyrock associated with quarry blasting. Most incidents of flyrock go unreported, concealing the true extent of the problem.

2) Blasting is "ultrahazardous" or "abnormally dangerous," and proposed quarries that intend to blast to extract aggregate must be restricted to sparsely populated rural areas, far removed from settlements, and appropriately setback from all wells, residences, livestock, infrastructure (e.g., major arterial roads and highways, gas lines, hydroelectric power lines,), sensitive landmarks, watercourses and topographical features.

3) The idea that residents and pets must hustle into their homes (which may not protect them or their homes from flyrock) at the alarming sound of warning horns and blasts is akin to being under siege in wartime, with the potential for long-term physical, emotional and psychological issues (e.g., sleep disturbance, hearing loss, Tinnitus, Post-traumatic Stress Disorder, respiratory illnesses from dust inhalation, etc.)

4) Petty fines and short-term licence suspensions in Ontario are an inadequate deterrent to operators of quarries who cause injury to the public, the environment, livestock, pets, and wildlife; damage services (e.g., well, septic, hydro, cable, gas); and destroy property values.

> ***"[B]etween 1973 and 1989, the Ministry [of Natural Resources] initiated 154 prosecutions and obtained 81 convictions. The total fines levied amounted to about $72,000." Comparing this to the enforcement record of the Minister of Environment and Energy, they point out that the Ministry of Natural Resources had therefore undertaken "fewer prosecutions over a 17-year period than the Ministry of Environment and Energy undertakes in a single year." They also note that as of 1993 the Ministry had not revoked any aggregate licences [p. 175]***.[177] [emphasis added]

5) Many of the potential adverse effects associated with quarry blasting could be avoided if a minimum setback of 800 metres from any sensitive land use (or activity) is imposed on an application for a new quarry or expansion of an existing quarry.

6) Proposed quarries or quarry expansions must be responsible for satisfying their own setback requirements within the lot limits and be precluded from imposing setback requirements on adjoining or nearby properties and unlawfully depriving third-party owners of their property rights and the use and enjoyment of their properties to the fullest extent permitted under the law.

7) Privately-owned quarries are for-profit entities which need to pay their own way, and if they are unable to satisfy appropriate setback requirements within the boundaries of their own land holdings they must be compelled to locate elsewhere or to acquire

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[177] Estair Suarez Van Wagner, "The Place of Private Property in Land Use Law: A Relational Examination of Ontario's Quarry Conflicts," *York University*, August 2017, PhD Dissertation.

adjoining property at market value, provided that in doing so the community will not be disrupted, destabilized, devalued and, ultimately, stigmatized.

8) There are Proximity Studies and numerous court cases supporting the conclusion that homes near blasting quarries sustain significant losses in market value, become stigmatized and over time erode homeowners' equity, with larger financial impacts experienced by homeowners of higher-priced residences.

9) The aggregate industry and the explosives engineers retained on their behalf are indifferent to the potential hazards of flyrock in Ontario. In preparing this research paper four *Blast Impact/Assessment Reports*, each prepared by a different engineer, were obtained from the internet, and none of the reports even mention the word "flyrock," let alone address the dangerous aspects of a blasting quarry operation. All four engineers are members of the Professional Engineers of Ontario. A previous version of this research paper along with the four *Blast Impact/Assessment Reports* and a covering letter outlining my concerns were emailed to the Professional Engineers of Ontario (twice addressed to the presiding President and twice to the person responsible for ethics issues), without ever receiving an acknowledgement. A brief extract of the covering letter addressed to the Professional Engineers is as follows:

> *It seems that if an engineer ignores flyrock, there is a failure to protect the public interest and that is a violation of your association's Code of Ethics, in particular,*
>
> *2. fidelity to public needs*
> *3. devotion to high ideals of personal honour and professional integrity*
> *4. knowledge of developments in the area of professional engineering relevant to any services that are undertaken*
> *5. competence in the performance of any professional engineering services that are undertaken*
>
> As to the omission of addressing **flyrock** in a **blasting impact report**, it also appears to point to **negligence** and **professional misconduct** under the *Professional Engineers Act, R.S.O. 1990, c. P.28*:
>
> *"negligence" means an act or an omission in the carrying out of the work of a practitioner that constitutes a failure to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances. R.R.O. 1990, Reg. 941, s. 72 (1); O. Reg. 657/100, s. 1 (1).*
>
> *"professional misconduct" means,*
>
> *a) negligence,*
> *b) failure to make reasonable provision for the safeguarding of life, health or property of a person who may be affected by the work for which the practitioner is responsible.*
>
> An investigation and reply by your professional association into the matter of flyrock, the most dangerous aspect of quarry blasting operations, would be much appreciated by our community as well as the general public.

Three of the engineers belong to the International Society of Explosives Engineers (ISEE), and their reports, along with a covering letter expressing my concerns about flyrock, were emailed to the Past President of ISEE, who forwarded my submission to the ISEE, but the ISEE did not acknowledge my submission. In a series of email exchanges with the Past President of ISEE, I was advised that ISEE does not address competency:

***Judgment of 'Competence' is not the provenance of this "so-called" professional society [ISEE].***

10) The Precautionary Principle, as contemplated by the Statement of Environmental Values (SEV), must be applied to all applications for aggregate licences to avoid potential major adverse environmental impacts, especially those that are potentially irreversible, and to avoid potential harm to human, animal and plant life. "What if" risk assessment scenarios and the feasibility of each scenario should be a mandatory component of every application for a quarry permit.

> ***[MNRF is committed to the 11 principles in the "Statement of Environmental Values"[178] when decisions that might significantly affect the environment need to be made, including the principle that "from both a sound business and environmental perspective, it is less costly and more effective to anticipate and prevent environmental impacts before undertaking new activities than it is to correct environmental problems after the fact." When decisions that might significantly affect the environment have to be made, MNRF "will take into account social, economic and other considerations."]*** [emphasis added]

11) Consultant reports commissioned by an applicant for an aggregate licence/permit that contain exculpatory clauses (or labelled "without prejudice"), and deny reliance on the report by third parties (e.g., MNRF, MOECC, municipality, impacted neighbours/citizen coalitions, etc.), such as the example that follows, should be rejected:

> *This report was prepared for the exclusive use of (Applicant). Any use which a third party makes of the report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. (Consultant) accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.*

It is important for all third-party approving governmental authorities (municipal, provincial and federal) and other impacted third-parties be allowed to rely on an applicant-commissioned consultant's report should the report turn out not to have been prepared to an acceptable standard and led to environmental harm, personal injury or property damage. Otherwise, a valid third-party claim of negligence against the consultant might not be sustained.

A third-party governmental agency overpaid for property at taxpayer expense by relying on an unauthorized appraisal report:

> *The February 12, 2013, 42-page appraisal was prepared for the exclusive use of Royalty Developments Limited (Pres: Anthony Marquart)…and lenders of their choosing, and they were listed as the only intended users of the appraisal report, which precluded the GTHA from relying on the report. The appraisal report has not been made public. In fact, the Saskatchewan Privacy Commissioner ordered all copies in the possession of the government destroyed or returned to the appraiser, as GTHA did not pay for the appraisal and because "the GTH was inappropriately provided a copy of the appraisal" without written authorization of the appraiser. In reaching this decision,…the Commissioner made note of the following restrictions placed in the appraiser's report:*
>
> - *The intended use of the appraisal is for internal uses of the client and to assist with financing arrangements relating to the subject property.*

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[178] MNRF's Statement of Environmental Values (SEV) can be found at https://ero.ontario.ca/page/sevs/statement-environmental-values-ministry-natural-resources-and-forestry.

- *It is not reasonable for any other person other than the client, the lender of the client's choice, and [the appraisal firm] to rely upon this appraisal without first obtaining written authorization from all parties.*
- *This report has been prepared on the assumption that no other person will rely on it for any other purpose and all liability to all such persons is denied. [para. 15] [emphasis added] Except as it may be necessary to expedite the function of this appraisal as identified herein, it is not reasonable for any person other than the client, the lender of the client's choice, and [the appraisal firm] to rely upon this appraisal without first obtaining written authorization from all parties. [para. 16]*
- *Neither possession of this report nor a copy of it carries with it the right of publication. All copyright is reserved to the author and is considered confidential by the author. It shall not be disclosed, quoted from or referred to, it [sic] whole or in part, or published in any manner without the expressed written consent of the client and [the appraisal firm]. [para. 16]*

*The GTHA failed to heed the disclaimers and cautions prominently placed up front in the appraisal report—not buried or deliberately concealed in the body of the report. There is nothing ambiguous about the language that would cause confusion or misunderstanding. No satisfactory explanation has been provided to justify the government's reliance on a report clearly marked as to the intended users and the intended use. Even if the GTHA had been an intended user of the appraisal, other aspects of the appraisal should have raised concerns.*[179]

[179] Tony Sevelka, "A Forensic Appraiser's Perspective: Government Overpaid for Land Relying on Unauthorized Appraisal," *The Canadian Appraiser* (Volume 63, Book 1/Tome 1, 2019). https://www.aicanada.ca/article/a-forensic-appraisers-perspective-government-overpaid-for-land-relying-on-unauthorized-appraisal.

# *SECTION II – DOCUMENTED FLYROCK INCIDENTS*

A sample of documented cases of flyrock that have caused various *adverse effects*, including personal injury and death, are summarized as follows:

### Flyrock 1

- On September 3, 2019, a blast at the Martin Farm Quarry in Clear Brook, Virginia, scattered flyrock on neighbouring properties. Flyrock was found in four separate locations, one at a distance of 700 feet (213 metres) and all with the potential to cause serious injury and damage to property. Stonewall Elementary School is located near the quarry.

  > *Neighbors of the company's Clear Brook facility have previously registered complaints about noise, light and air pollution, and traffic caused by Carmeuse's mining. A large mound of debris currently surrounding a portion of the quarry is considered an eyesore by some residents because it is visible from Martinsburg Pike (U.S. 11) and nearby neighborhoods.*

  https://www.aggman.com/quarry-blast-sends-fly-rock-into-yards-of-neighboring-homes/.

### Flyrock 2

- On April 10, 2018, during a standard drill and blast operation at Albury Quarry, northeast of Albury, New South Wales, flyrock flew between 300 and 340 metres from the blast location, striking three light vehicles parked a short distance away from people. Seven people narrowly escaped being injured by flyrock. **The blasting contractor estimated the blast exclusion zone for personnel to be 400 to 500 metres from the blast site** [emphasis added]. The incident was not immediately reported, and did not come to the attention of the NSW Resources Regulator until September 7, 2018.

  > *"Dangerous incidents must be reported to the NSW Resources Regulator in accordance with section 15 of the Work Health and Safety (Mines and Petroleum Sites) Act 2013 and regulations."*

  https://www.quarrymagazine.com/Article/9011/Flyrock-incident-in-NSW-quarry.

### Flyrock 3

- On August 8, 2017, a blast at Jefferson Quarry, Minnesota, sent flyrock as large as 82 pounds (37 kilograms) into a residential neighbourhood. One rock sailed a distance of about 570 feet (174 metres) punching a hole in the siding of a home, another sheared off large tree branches, and a witness described the sound of dozens of rocks flying through treetops and bouncing off roofs. A building struck by one of the larger rocks is city-owned subsidized housing apartment building. "**Police found seven [rocks] in the residential area weighing 10 pounds or more, including a 48-pounder, a 68-pounder and one that topped 82 pounds. The 82-pounder was 19 inches by 8 inches by 9 inches**." The quarry owner had its blasting permit suspended.

  > *Tim Slipy, a Mankato resident who lives next door to the home that was struck by one of the large flying rocks, told the news agency that the blasts are frequent enough that he gave little thought to the quarry's warning horn on August 8. "The horn blew. They do three blows before a blast, and about a minute later it goes off," Slipy said. "This one, they did three blasts and, about five seconds later, there was a blast." Then he noticed the sound of the rocks flying through the air.*

An investigation of the August 8, 2017 quarry blast disclosed that,

> *In regard to loading and detonating the explosives…everything was pretty routine other than one or two holes that seemed to be leaking explosives, the workers…told Mankato fire and police officials.*
>
> ***[W]orkers were pouring 4,124 pounds of ammonium nitrate and fuel oil into 47 holes that had been drilled deep into a shelf of limestone. Known as ANFO, the legal explosive was the same type used by terrorist Timothy McVeigh in 1995's Oklahoma City bombing, and the amount was only about 18 percent less than the 4,800 pounds McVeigh detonated outside the Alfred P. Murrah Federal Building, killing 168 people. This time the ANFO was being used by certified explosives experts with hundreds of blasts on their resumes***.[180] [emphasis added]

The same quarry had its blasting permit suspended for 60 days following a prior blast on April 25, 2017 that was immediately followed by an earthquake-like tremor measuring 2.8 on the Richter scale, and strong enough to rattle buildings, prompting more than two dozen property damage reports.[181] U.S. Geological Survey scientists said it's unlikely the tremors occurred naturally.[182] After the August 8, 2017 quarry blast, the, the quarry's blasting permit was again suspended, and the Department of Public Safety informed Jordan Sands it would not reactivate the permit.[183]

**Following an investigation into the August 8, 2017 incident, the Attorney's office decided against criminal charges as it would be difficult to prove a "negligent discharge," a charge that can be levelled when someone "negligently causes an explosive or blasting agent to be discharged" in a manner that was in "gross disregard for human life or property**."
https://www.aggman.com/blasting-permit-suspended-for-mankato-quarry-after-large-rocks-fly-into-neighborhood/.

### Flyrock 4

- On August 2, 2017, an explosion at a Jamestown quarry sent flyrock and debris into a residential area causing damage to homes. **A rock went through the roof of a house on Kivitt Drive**. ROX8 received numerous calls about the blast felt near Riverdale Drive and Kivitt Drive.
  https://myfox8.com/news/houses-damaged-after-rock-quarry-explosion-in jamestown/.

### Flyrock 5

- On May 17, 2017, six workers were exposed to the risk of death or serious injury when flyrock from mine blasting landed near the workers, within the mine's **500 metre personal exclusion zone** at the Moolarben Coal Mine near Mudgee. The workers were

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180 https://www.mankatofreepress.com/news/local_news/when-a-blast-goes-wrong-investigation-raising-questions-about-proper/article_4ca204bc-b5cf-11e7-a675-9f0c59ef8bc4.html.

181 "Criminal charges possible in quarry blast," *The Free Press*, September 22, 2017, https://www.mankatofreepress.com/news/local_news/criminal-charges-possible-in-quarry-blast/article_32e3fd88-9fb7-11e7-b0eb-9b4c6c47ff17.html.

182 https://www.insurancejournal.com/news/midwest/2017/08/17/461435.htm.

183 "County attorney declines to file charges in quarry blast," *The Free Press,* October 11, 2017, https://www.mankatofreepress.com/news/local_news/county-attorney-declines-to-file-charges-in-quarry-blast/article_ed0f241e-aece-11e7-b449-0bee8d49d9c0.html.

standing 246 metres from the blast site, and a 20 kg rock landed on a light vehicle. (**One of the workers had suggested to the group that they should report to the mine that the damage to the vehicle was caused by the car hitting a kangaroo while being driven off site**.)[184] The operator and one of its former contract workers were taken to court by the NSW Resources Regulator for alleged contraventions of the *Work Health and Safety Act*. **The alleged offences carry a maximum penalty of $1.5 million in the case of the operator and $300,000 in the case of the contract worker.**
https://www.aihs.org.au/news-and-publications/news/moolarben-coal-operators-face-court-after-dangerous-shot-firing-incident.

### Flyrock 6

- On March 22, 2016, **Tracy L. Hockemeier was killed instantly when he was struck in the head by flyrock, weighing approximately 20 pounds (9 kilograms) and travelling at about 240 mph (386 kph) at the point of impact**, during blasting operations in the Winterset section of Plant 862 in Madison County, Earlham, Iowa. Hockemeier was sitting in a pickup truck, approximately 1,200 feet (366 metres) from the blast site, preventing others from entering the blast area. When the blast was initiated, flyrock was propelled upward, landing on and penetrating the roof of the truck and striking the victim.

> *The mine operator failed to ensure that either the operator or the blasting contractor designated a safe distance from the blast site as a "blast area" to be cleared of persons prior to the blast. The mine operator also failed to ensure that either the operator or the blasting contractor adequately assessed and considered several of the factors listed in 30 C.F.R. § 56.2 in determining the boundaries of the "blast area" as that term is used in 30 C.F.R. § 56.6306(e). Those factors included, but were not limited to, the poor geologic conditions of the blast site and the material to be blasted; the loose rock; the voids, cracks and mud seams encountered during the drilling and loading process; the excessive water and mud infiltration into the blast holes, and the loss of loadable drilled holes due to excessive mud and water; powder factors; stemming issues; the operator's blasting experience; and the effect of these factors on the potential distance of fly rock.* ***Proper and adequate consideration of such factors would have led a reasonable and prudent operator and blaster to determine that the safe boundary of the blast area should have been further away from the blast site than the approximately 1,200 feet [366 metres] that the leadman was positioned from the blast site at the time of the blast***. [emphasis added]

https://www.msha.gov/data-reports/fatality-reports/2016/fatality-3-march-22-2016/final-report.

### Flyrock 7

- On September 19, 2016, a blast at Gateway Materials quarry sent rocks flying onto an occupied Halifax apartment building more than a kilometer (1,000 metres) away. The blast threw rocks over the Bicentennial Highway and struck Parkland Arms apartment building at 390 Parkland Drive.[185] The explosives company pleaded guilty to an Occupational Health and Safety Act charge. In 2005, the same company was fined

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[184] "Executive Summary," https://www.resourcesregulator.nsw.gov.au/__data/assets/pdf_file/0008/1086677/Investigation-Report-Moolarben-Shot-Firing-Incident.pdf.

[185] Reportedly, City Centre Property Management filed a lawsuit against Gateway Materials Ltd. and B.D. Stevens Ltd. in the Nova Scotia Supreme Court in September 2018.

$43,500 for a more serious incident that damaged the same building on August 13, 2003. Flyrock ranging in mass from pebbles to 150 kilograms crashed into the same apartment building. One rock smashed through the ceiling of a top-floor apartment, while another bounced off the parking lot and shattered a window on the ground floor. https://www.thechronicleherald.ca/news/local/blasting-company-fined-40000-after-rocks-hit-apartments-in-2016-halifax-mishap-257818/.

**Flyrock 8**

- On October 16, 2015, flyrock from a blast at Adams Claim Mine, Nevada, was uncovered on October 19, 2015 by a neighbour on her property, distant 700 feet (213 metres) from the blast to the lot limit of her property.

> *On October 19, 2015, a private citizen filed a hazard complaint with MSHA alleging that flyrock from blasting operations at the Adams Claim Mine had fallen on her residential property….The complaint alleged that she was outside at the time and could hear flyrock landing around her….In addition, the complaint alleged that this had happened two other times, once in September 2015 and once in August 2011….*[3]
>
> *At hearing, Lloyd opined that, depending on the velocity of the rocks, there would be an indentation where they hit the ground….According to Wilmoth, the gypsum seen in the pictures was the same material mined at the neighboring Adams Claim Mine…..The photographs, which included a MSHA investigation folder in the frame for scale, show that the pieces of gypsum ranged in size from slightly smaller than a baseball to slightly larger than a softball….Based on the bright white color of the material and the lack of weathering, Wilmoth determined that the material was "fresh" and "didn't appear to have been there for a [long] period of time[.]"….Other material from the mine site was also observed on the residential property at the time, but it was easily distinguishable due to discoloration and browning from dirt buildup….Wilmoth estimated that the rocks traveled between 200 and 500 yards from the location of the blast to where the rocks were found.*
>
> ***Inspector Joshua K. Wilmoth[1] determined that an injury was reasonably likely to be sustained and, if an injury were sustained, it could reasonably be expected to be fatal.*** [emphasis added]

https://www.fmshrc.gov/decisions/alj/ALJd_12202016-WEST%202016-209.htm#_ftn3.

**Flyrock 9**

- On May 21, 2015, a blast at a Loudoun County, Virginia, quarry sent rocks and debris smashing into homes and cars, leaving one person injured. A security camera video shows a rock flying through the air and shattering glass in the nearby Fairfax Auto Parts store, and a half dozen cars damaged in the store's parking lot. Three large windows at the store were shattered when a rock went through the front of the store. Employees said they are used to the building shaking from nearby quarry blasts, but the size of these rocks was unprecedented. A huge rock from the quarry tore through the roof of a house a half mile (805 metres) away and landed in a bedroom. The person who was sleeping in the bedroom was cut by debris that fell from the ceiling and needed eight stitches.

> *Investigators from the Virginia Department of Mines, Minerals and Energy were at the quarry May 22 and were to return there this week, agency spokesperson Tarak Kesterson said.* ***One man was injured by debris from a rock and was stitched up at an area hospital****, Kesterson said, and the Loudoun Department of Fire, Rescue & Emergency Management said there was other damage after the May 21 incident****. Perhaps the most talked-about scene was at a***

> ***NAPA auto parts store in Sterling. Rocks showered the parking lot, damaging cars and breaking a store window. And at a nearby home, a large rock crashed through the roof into a bedroom. Some residents thought a meteor shower was to blame****….Loudoun County Fire Marshall Office's Deputy Chief Linda Hale said authorities, both locally and at the state and federal levels, take situations like this very seriously. "****When it comes to blasting, any time you have rock that leaves your property, that's considered a serious offense****," she said.* [emphasis added]

Jonathan Hunley, "Blast Sends Rocks Flying, Ashburn Today, May 28, 2015, https://issuu.com/leesburgtoday/docs/05-28-15_lt_at_issue.
https://www.nbcwashington.com/news/local/Sterling-Quarry-Blast-Sends-Rocks-Into-Cars-Buildings-304624031.html

**Flyrock 10**

- On May 28, 2014, one of Consbec's controlled blasts resulted in flyrock being projected outside the blasting area and onto a neighbouring residential property, approximately twenty-five (25) feet from where the homeowner and an employee of Bruman were standing. Consbec Inc. and Bruman Construction Inc. were fined a total of $150,000 for failing to notify the *Ministry of the Environment and Climate Change* ("MOECC") of a flyrock discharge from a quarry in North Bay.
  https://www.siskinds.com/failure-notify-brings-150000-fine-despite-no-damage-property/.

**Flyrock 11**

- On September 3, 2014 Rock Breakers executed a blast at the quarry in Merrick Township that caused errant flyrock to project outside of the blast area and onto a neighboring residential property. Flyrock the size of a basketball among other pieces landed 50 to 75 meters from the front door of the residence. Rock Breakers failed to report the flyrock discharge. Rock Breakers (2007) Inc. pleaded guilty to two offences for discharging or permitting the discharge of flyrock into the natural environment, which may have caused an adverse effect, and for failing to report the discharge, contrary to the *Environmental Protection Act*. Rock Breakers (2007) Inc. was fined a total of $60,000 plus a victim fine surcharge of $15,000.
  https://news.ontario.ca/ene/en/2015/11/drilling-and-blasting-contractor-fined-60000-for-fly-rock-discharge-and-failing-to-report-incident.html

**Flyrock 12**

- On July 19, 2013, an explosion at a quarry in Nepal hurled rocks and debris around a kilometer radius. Flyrock struck and killed one person in a factory 500 metres away, and eleven others were injured in the hail of rocks, and 14 other factories were damaged. Twenty cars were crushed by flying boulders. A total of 37 department personnel from the local fire departments were dispatched to the scene. https://www.thestar.com.my/news/nation/2013/07/20/one-killed-in-quarry-site-explosion

> ***A factory worker was killed while 10 others were injured after being hit by rock debris from an explosion at a quarry located along Jalan Bukit 2 of the Seri Alam Industrial Area here today. Johor Fire and Rescue Operations assistant director, Mohd Rizal Buang said the incident at 12.30pm also damaged 18 cars and 14 factories along the road and a Tenaga Nasional Berhad substation. He said rock fragments were hurled as far as one kilometre [1,000 metres] away from the quarry concerned. "The dead worker was a***

> ***Nepalese in his 30's and he died at the factory site after being hit by several large pieces of rock. The factory is only 500 metres from the quarry," he told reporters at the scene. Mohd Rizal said the department received a report on the incident at 1.14pm before the first fire engine…arrived at the site at 1.42pm. He said a team of 37 fire and rescue personnel later carried out a search and rescue operation with the assistance of 16 policemen and TNB employees before declaring the area safe for the public…."The victim's body was sent to Sultan Ismail Hospital here for a post-mortem while all injured were sent to the same hospital for treatment. The search and rescue operation has ended and the case had been handed over to police for further action," he said. – Bernama*** [emphasis added]

https://www.malaymail.com/news/malaysia/2013/07/19/one-killed-10-injured-in-johor-quarry-blast/497371.

### Flyrock 13

- On September 20, 2011, blasting at a Vancouver Island (Shawnigan Lake) gravel quarry hurled baseball-sized, jagged rocks 400 to 500 meters, striking three people. One woman had her arm severed below the elbow, and two men were seriously injured. Boulders rained onto nearby truck yards, with one rock breaking a piece of one-inch plywood on a flatdeck truck in the driveway.[186]

> ***A woman is in critical condition after her arm was severed in industrial blast at a gravel pit in Shawnigan Lake on Vancouver Island. An explosion at Mid Island Aggregate on Tuesday afternoon sent rocks flying 400 to 500 metres toward a group of people who were then injured, said RCMP Sgt. Rob Webb. The woman in her 50s had her right are wavered near the elbow, said Webb. Two men in their 40s and early 50s were also taken to the Victoria General Hospital where they are in stable condition. I can say the one male that was hit in the head, likely the hard hat saved his life," said Webb….***[emphasis added]

> ***"Today's blast was unusual. It was loud and shook our whole building," Charlie McGill, Manager of Westland Industrial. "We got up from our desks, ran outside ant that's when we noted the rocks coming down onto our lot." Rocks bigger than baseballs rained down onto businesses in the industrial area below the gravel pit. It felt like a car bomb went off or an earthquake, said Lisa Channell, who works at an aggregate company nearby. "They blast up there all the time and we don't usually feel anything from it. So something went horribly wrong." It definitely reverberated into the chest," said Bill Shifflett, who was working at a neighbouring mill****. "It wasn't a scheduled blast because there was no typical beep beep beep seven times and then seconds, maybe thirty seconds, and then boom! That's when the blast hits."* [emphasis added]

**(The B.C. government released a practical guidebook to help promote safety in aggregate mining operations in January 2008, after four workers were killed in separate incidents in B.C.'s quarries in 2007.)**
https://canada.constructconnect.com/joc/news/projects/2011/09/investigation-launched-after-explosion-at-vancouver-island-gravel-quarry-injures-three-workers-joc046827w.

### Flyrock 14

- On April 11, 2011, **Flyrock weighing 86 pounds was hurled 407 feet (124 metres) from the blast site at the Cookeville Limestone Quarry and penetrated the roof of the home of Ms. Sarah P. Hudgens at 1250 Skyline Drive in Cookeville, Tennessee, and landed in the bedroom**.

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[186] https://bc.ctvnews.ca/gravel-pit-blast-severs-woman-s-arm-injures-2-1.700846.

> ***On April 11, 2011, at 12:15 p.m., Mr. Hudgens arrived at his home for lunch…..When Mr. Hudgens entered his home, he observed a cloud of dust in the air, appearing to originate from his bedroom….Once in his bedroom, Mr. Hudgens observed a large rock, later determined to weigh 86 pounds, and a hole in the ceiling, where the rock had entered through the roof….The rock crushed a chest of drawers on impact and caused extensive damage to the home, including knocking out a window, creating cracks on the inside and outside walls of the home, and strewing insulation, remnants of ceiling joists, and other debris across a 10 foot area of his bedroom….A rocking chair next to the drawers was covered in at least a foot of insulation*** ***pulled down from the ceiling by the rock***. [emphasis added]
>
> *The rock was determined to be flyrock propelled from a blast at Cookeville Limestone Quarry….The flyrock landed over 400 feet from the site of the blast….Previous blasts at the Cookeville Limestone Quarry caused dust to be carried up the hill to his home and neighbors' property, covering cars and porches, but, in those instances, the Hudgens' home was not physically damaged….Prior to April 11, Mr. Hudgens claimed that he experienced shockwaves and the smell of noxious fumes originating from the quarry at least once a month, though he agreed that he never had to be treated for dust or fume inhalation by a doctor….However, Mr. Hudgens testified that a neighbor, Asher Lefebvre, experienced breathing difficulty due in part to the effect of dust….Mr. Hudgens also testified that shockwaves from blasting caused damage to the doors, windows, and bricks of the Lefebvre home.*

https://www.fmshrc.gov/decisions/alj/ALJ_12172013-SE%202011-583.pdf.

## Flyrock 15

- On February 24, 2011, a blast at Brayford Quarry sent flyrock 200 metres onto public roads and damaged waiting cars, and narrowly struck a workmen who had halted traffic while the blasting took place. The two cars waiting in the queue on a nearby public road were hit by flyrock, which dented the bonnet of one and shattered the windscreen of the other. HSE inspectors discovered an 8.5 kilogram rock on the other side of the road, and six smaller pieces of flyrock were recovered from the road. Both the blaster and the quarry owner pleaded guilty in Barnstaple Magistrates' Court and were fined. After the hearing,

> ***HSE Inspector of Quarries, Mike Tetley, said: 'This was a very serious incident that could easily have led to death or serious injury. 'Blasting operations at quarries are inherently high risk, and these risks must be rigorously controlled by good explosives engineering practice and in accordance with legal requirements.*** [emphasis added]

https://www.agg-net.com/news/firms-fined-for-quarry-blast-damage.

## Flyrock 16

- On May 12, 2010, the discharge of flyrock caused damage to a garage in Magnetawan, Ontario. Castonguay had been hired to do blasting at a nearby quarry located on Old Hwy Road West.

> *The Ontario Court of Justice…added a couple of expensive [sic] postscripts to a landmark legal case that confirmed the incident reporting requirements under section 15(1) of Ontario's* Environmental Protection Act. ***Castonguay Blasting Ltd. was found guilty (yet again) of failing to report the discharge of a "contaminant" (fly rock from its blasting operations) that caused or is likely to cause an "adverse effect" (damage to a movie theatre, parked cars and a garage) in three separate incidents***.[187] [emphasis added]

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[187] Marc McAree, "Castonguay Convicted Again: Ontario Courts Continue To Recognize Section 15(1) EPA 'Duty to Report,'" https://www.willmsshier.com/docs/default-source/articles/castonguay-convicted-again.pdf?utm_source=Mondaq&utm_medium=syndication&utm_campaign=View-Original.

The Parry Sound Court fined Castonguay $75,000 (plus a victim fine surcharge of $18,750) for failing to notify the MOE about the discharge of fly rock.
https://news.ontario.ca/ene/en/2014/03/dnx-castonguay-inc-fined-75000-for-failing-to-report-discharge-of-fly-rock.html

### Flyrock 17

- On August 29, 2009, flyrock was ejected from the permit blast area of F10 Alum Luck Mine, and damaged a nearby home.

> *Austin [Powder] relates that on August 28, 2009 a blasting at its mine caused a rock to exit the mine property, damaging a nearby home.*
>
> ***...[Austin Powder} admits that less than 2 months after the August 2009 blasting event, as described above, another event occurred in which flyrock struck a home, causing a hole in the home's roof****. However, Austin denies that hole in the home's roof was created by flyrock. That disputed event at least resulted in MSHA's issuance of Citation Number 8237123…issued on October 28, 2009.* [emphasis added]

https://www.fmshrc.gov/decisions/alj/ALJ.11142011-KENT2010-495o.htm.

### Flyrock 18

- On July 20 and 23, 2009 during blasting flyrock was discharged beyond the control area of 200 metres at a limestone quarry near Arnprior, Ontario. In the first incident, a small rock struck a worker at a neighbouring business on the arm. In the second incident, rocks were observed flying well beyond the control area. A scale house located 230 metres from the blast was struck by a number of rocks. Two vehicles held at a controlled stop along nearby Young Road on the edge of the quarry property located about 300 metres from the blast were also struck by rock resulting in extensive damage. The blast damaged property and impaired the safety of people. "**It was also determined that the control zone should have been 500 metres for blasting of this nature at the quarry**." [emphasis added] Perth-Austin Powder Ltd. was fined $130,000 plus 25% Victim Fine Surcharge after pleading guilty to discharging flyrock into the natural environment causing off-site impacts and failing to report the discharges, contrary to the *Environmental Protection Act*.
https://news.ontario.ca/ene/en/2014/04/burlington-firm-fined-130000-for-arnprior-blasting-offences.html

### Flyrock 19

- On September 24, 2008, flyrock from a quarry blast detonated by Maine Drilling and Blasting in South Burlington, Vermont, was thrown several hundred yards and did over a million dollars in damage to vehicles, buildings and airplanes at the Burlington International Airport (para. 44).[188] The same company had a blast go awry in Raymond, NH, on April 25, 2005, with flyrock doing damage to buildings and vehicles over 1,000 feet (305 metres) away.
https://www.valleyreporter.com/index.php/news/my-view/4368-.

[188] http://www.killthealbionquarry.org/flyrock_danger.pdf.

### Flyrock 20

- On May 6, 2008, flyrock ranging from small pebbles to 22 kilogram (49 pound) boulders rained down on a trailer park in Whitehorse, Yukon Territory (Canadian Press, 2010). The rocks were launched up to 140 metres from the blast site and destroyed a shed, crashed into living rooms of occupied trailers (as seen in Figure 8), and sent one tenant running for his life (Davidson, 2010).[189] At trial, the judge concluded that the blaster acted irresponsibly, while noting that blasting is "inherently dangerous":

> *"It wasn't until 'well after' the May 6 blast that Hildebrand [the blaster] ever saw a map showing the distance between the boulevard extension and the homes. 'I have no hesitation in finding that both Sidhu Trucking and Mr. Cratty failed in their duty because they did not ensure that Mr. Hildebrand was properly oriented to the site so as to be aware of the close proximity of persons or property likely to be affected by the blasting operations,' Faulkner [the judge] wrote. 'Moreover, **blasting is an inherently dangerous undertaking,** [**emphasis** added] and it would be common sense to be well aware of the distance to persons or structures -- especially in an urban area'" (Canadian Press, 2010).*

### Flyrock 21

- On April 22, 2008, flyrock from a blast at Percy Quarry, Morristown, Vermont, consisting of rocks four to eleven inches long, struck "neighboring houses and the Morristown Highway Garage [686 feet or 209 metres]." "Smaller pieces of flyrock impacted neighboring homes [Pine Crest mobile home park] with so much force the flyrock was found embedded in a metal post and a lawn landscaping rock." The Morristown garage is located about 686 feet from the blast site, and in a different direction than the mobile home park (718 feet or 219 metres). A subsequent incident at the Percy Quarry on September 9, 2008 again saw flyrock thrown into Pine Crest mobile home park.

### Flyrock 22

- On August 22, 2007, blasting at Miller Braeside quarry in the Township of McNab/Braeside hurled flyrock that structurally damaged the foundation of one home and another home (in another direction) took the brunt of the flyrock. Flyrock struck the Jameses' residence and vehicle, reportedly, causing $250,000 in damages.[190] Subsequently, the Jameses filed an action against the quarry owner and the blasting company claiming damages of $250,000.

  **A prior blasting incident in September 2005, labeled the "megablast," caused damage to residences, driveways and wells. Reportedly, some neighbours received compensation but only if they signed a confidentiality agreement, and to never come after Miller again for any damages. "One neighbor, Mr. Battiston, described flyrock that landed on his roof over 400 metres from the site."[191] The vibrations in the bedrock from the blast caused one of two wells of a neighbouring farmer to go dry, and a new well had to be dug, for which, reportedly, no compensation was received. The water from the other well was so**

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[189] "Regulatory Mitigation of the Adverse Environmental Effects of urban Blasting," Jeffrey Thomas Loeb, A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Applied Science, 2010, p. 41. https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0050876#downloadfiles.
[190] *James v. Miller Group Inc*, 2013 ONSC 3266 (CanLII), <http://canlii.ca/t/g2f5j>, retrieved on 2019-10-12.
[191] *Miller Paving Ltd.,* PL130785, OMB, October 27, 2015 [para. 55].

**murky that water for his cattle had to be hauled from the Ottawa River for a number of days**. After the second flyrock incidence, the MOE charged the company and issued a $25,000 fine.
https://www.insideottawavalley.com/news-story/4508046-company-guilty-of-pakenham-blasting-mishap/.

### Flyrock 23

- On July 16, 2007, **flyrock from a blast at Three Mile Mine #1 traveled outside the permit zone a distance of 1,570 feet (479 metres), and struck a mechanic working in the staging area, killing him instantly**.

> *In her initial brief, the Secretary asserted that the ground plan "was not sufficient to prevent the creation of flyrock during the shot that fatally injured the victim." (Sec. Br. at 8). Subsequently, in a response to the order issued on December 29, 2010, the Secretary asserts inter alia, as follows:*
>
> > *"the ground control plan did not provide sufficient protection to assure proper drilling and blasting precautions to provide adequate burden to prevent blowout of blast holes along the blast site."*
>
> ***Goble [the blaster] acknowledged that he determined the blasting area but was unable to remember what he "consider[ed]" it to be…. Nor did he testify specifically as to the factors that he took into account in setting the blasting area***. [emphasis added]
>
> *Thomas Edward Lobb was offered by the Secretary as an expert in explosives and blasting. He testified that a determination of what constitutes a blasting area is based "[o]n previous issuances of flyrock, the type of material that they're (sic.) blasting, the timing of the individual blastholes, and any material that's in front of the blast, such as an old spoil."….It also is based on geology, the accuracy of the drilling, and the types of explosives being used.*
> https://www.fmshrc.gov/decisions/alj/Kt2008-390.htm.

### Flyrock 24

- On June 11, 2007, in West Lebanon, NH, Green Mountain Explosives detonated a quarry blast that resulted in flyrock being thrown 3,000 feet (10 football fields) into an industrial park doing damage to a building and 11 vehicles in the Technica USA parking. This same blast also sent flyrock about 4,000 feet (1,219 m) in another direction that landed on a runway of West Lebanon Airport, spreading dirt and debris. Tim Rath, manager of Technical Services of Green Mountain Explosives, represented Rivers as their blasting expert in environmental court.[192] On May 2, 2016,

  Rath testified at an environmental hearing[193] **that during a blasting event the nearby residents near [proposed] Rivers' Quarry [93 acres] should be in their homes and**

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[192] In a 71-page decision, the Vermont Environmental Court concluded "that the proposed Rivers quarry would not 'fit' into its surrounding area, which has been designated and is actively used as a scenic resource, and will therefore bring an undue adverse impact upon this area. The proposed quarry does not conform to criterion 8. The noises and activity that the proposed quarry will bring to this area will be unique; they are not currently experienced in any fashion within the Ag-Res District and along the scenic corridor that is Route 100B." The court concluded that "Rivers quarry, as proposed, is in conflict with…the use and enjoyment of neighboring properties." https://www.vermontjudiciary.org/sites/default/files/documents/Rivers%20Development%20LLC-1.pdf.

[193] State of Vermont "Act 250 hearing" is conducted by a three-member District Environmental Commission.

**not out on their property. When asked specifically about the danger from flyrock, Mr. Rath said that,**

> ***"You can never say never." No matter how careful a blaster is there is no certainty a blast will not cause flyrock. There are over 20 homes within 3,000 feet [914 metres] of the proposed quarry with the closest property lines just over 200 feet [61 metres] away.*** [emphasis added]

http://www.killthealbionquarry.org/DEATH-FROM-THE-SKY-FLYROCK.html.

## Flyrock 25

- On May 4, 2007, a blast set off at the Pattersonville Plant #61, a surface crushed stone operation, resulted in flyrock travelling approximately 526 feet (160 metres) onto New York State Thruway I-90, striking three vehicles and resulting in two injuries. A charter bus traveling west was struck by a rock weighing about 100 pounds (45.4 kilograms) that penetrated the roof and injured a teenager. The driver of a vehicle travelling east was struck in the abdomen after rock shattered the windshield. A third vehicle struck by flyrock received a broken windshield and dents to the hood.

> ***On** May 4, 2007, the blasting contractor set off a production shot in the quarry that resulted in flyrock traveling approximately 526 feet onto the New York State Thruway I-90, striking three vehicles and resulting in two injuries. The section of I-90 adjacent to the blast site was within the "blast area" and was not guarded or barricaded to prevent the passage of persons or vehicles. **The blaster in charge of the shot engaged in aggravated conduct constituting more than ordinary negligence. He knew or had reason to know that conditions including loose rock and minimal stemming in drill holes at the blast site created a significant hazard or flyrock throughout the blast area. However, he did not correct these conditions, stop traffic from passing through the blast area, or modify the blast design to reduce the hazard**.* [emphasis added]
>
> ***I agree with the Secretary's reasonable interpretation that Orica is not absolved of its duty to protect people in the blast area from injury merely because the blast area extended beyond the legal property line of the Pattersonville mine. To only include flyrock injuries on roadways that are "private" and/or "appurtenant to" a mine would allow blasting operators to escape liability for violations of section 56.6306 that result in injuries simply because the injuries occur off of the mine property. Accordingly, I find that MSHA's authority and jurisdiction are proper in this case**.* [emphasis added]

https://fmshrc.gov/decisions/alj/Yk2007-74o.htm.

## Flyrock 26

- On April 25, 2006, **a blast at Stuart M. Perry Quarry launched 13 boulders across Route 7 and into the yards of residents of Blue Ridge Estates and J.J. Corner Store, in Clark County, Virginia**. One rock damaged a neighbour's Ford Explorer. Another 50-pound rock flew 1,706 feet (520 metres).

> *Vehicles and buildings located on the opposite side of the four-lane highway [Route 7] struck and damaged; a store owner was nearly struck by two large rocks [p. A9 –Department of Mines, Minerals, and Energy, Division of Mineral Mines, Surface Blaster's Certificate Study Guide, November 2019]*

https://www.aggregateresearch.com/news/state-investigates-quarry-blast/

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Their responsibility is to consider evidence presented by legally designated parties and to evaluate each Act 250 application in accordance with the 10 Criteria." https://nrb.vermont.gov/sites/nrb/files/documents/Act%20250%20Hearing%20Information_0.pdf.

https://www.dmme.virginia.gov/DMM/PDF/TRAINING/REFRESHER/lawchanges/ARBlastingRegChanges2009.pdf.

**Flyrock 27**

- On January 10, 2006, a blast at the quarry of Denis Tarrant & Sons Limited, Kilfeacle, Co. Tipperary. Ireland, hurled flyrock over 300 metres and caused widespread damage to quarry plant, private cars and buildings within the quarry complex. **Three people were also injured**.
  https://www.hsa.ie/eng/Topics/Inspections/Prosecutions/Prosecutions_2009/.

  In rejecting the proposed Rivers' Quarry, the environmental court concluded that,

  > *Blasting at the proposed quarry would have several materially adverse impacts upon the surrounding properties and uses, including substantial risks to the neighbors' water supply from toxic chemical spills and altered groundwater flow patterns, air quality impacts from dust, and aesthetic impacts including noise over 70 dBA beyond the Rivers' property line…and the hazard that flyrock poses to neighboring properties and uses.*

**Flyrock 28**

- In December 2005, the NSW Department of Primary Industries issued a Safety Alert following a flyrock incident at a quarry. During a quarry blast, flyrock was projected more than 500 metres onto the Pacific Highway. A rock of approximately 100mm diameter was also projected onto a nearby property where it caused damage to a shed and parked vehicle. In addition, the windscreen of a front end loader in the quarry was broken. The drilling and blasting was carried out some 36 metres below the top level of the pit.
  https://www.resourcesandgeoscience.nsw.gov.au/__data/assets/pdf_file/0010/66376/Safety-Alert-05-16-Blast-Control-Flyrock-incident.pdf.

**Flyrock 29**

- On August 13, 2003, a blast at Gateway Materials quarry launched flyrock into an occupied Halifax apartment building more than a kilometer (1,000 metres) away. **Flyrock flew over the Bicentennial Highway and struck Parkland Arms apartment building at 390 Parkland Drive. Flyrock ranging in mass from pebbles to 150 kilograms crashed into the building. One rock smashed through the ceiling of a top-floor apartment, while another bounced off the parking lot and shattered a window on the ground floor**. Again, on September 19, 2016, a blast at Gateway Materials quarry sent rocks flying into the same apartment building.[194] The explosives company pleaded guilty to an Occupational Health and Safety Act charge. In 2005, the company was fined $43,500 for the August 13, 2003 flyrock incident.
  https://www.thechronicleherald.ca/news/local/blasting-company-fined-40000-after-rocks-hit-apartments-in-2016-halifax-mishap-257818/.

**Flyrock 30**

- According to a "Flyrock Hazard Alert" issued by the Virginia Department of Mines Minerals and Energy, "**flyrock can travel 3,000 feet [914 m] or more, reach speeds of 400 miles per hour, and can penetrate buildings, smash vehicles, and cause**

[194] Reportedly, City Centre Property Management filed a lawsuit against Gateway Materials Ltd. and B.D. Stevens Ltd. in the Nova Scotia Supreme Court in September 2018.

**great bodily harm**." "From December 2003 through August 2006, five serious flyrock incidents have occurred from blasting at surface mineral mines/quarries in Virginia." https://www.dmme.virginia.gov/dmm/PDF/SAFETY/ALERTS/blastingflyrock/FlyrockHazardAlert.pdf.

### Flyrock 31

- On July 16, 2004 and again on August 4, 2004, during the construction of the Red Hill Valley Parkway, debris from blasting conducted by Comsbec dispersed into a residential area causing significant property damage:

> ***…[O]n July 16, 2004 when the defendant [Comsbec] detonated a blast which caused a piece of rubber matting approximately 12-18 inches long to separate from a blasting mat and travel off site in an easterly direction. The pieces of blasting mat hit and damaged the roof of a house at 83 Kingsview Drive, Hamilton and then landed in the yard."*** [emphasis added]

> ***[On August 4, 2004,] "Flyrock went through the roof at 71 Davis Crescent breaking through shingle and plywood and creating a hole approximately 10 inches in diameter in the drywall ceiling of the upstairs guest room. The flyrock also damaged a vehicle parked in front of 79 Davis Crescent, and damaged a vehicle and driveway as well as some house brick and a fence board at 75 Davis Crescent."***[195] [emphasis added]

Comsbec failed to report the incidents to the Ministry of the Environment (MOE) as required by law. The MOE filed charges against Comsbec only after Environment Hamilton and Lake Ontario Waterkeeper filed a legal brief in August 2004. In an agreed statement of facts, Comsbec pleaded guilty in the Ontario Court of Justice and was fined $17,500. Comsbec also paid to repair the property damages caused by the blasting.

### Flyrock 32

- According to a May 10, 2002 DSMRE inspection report, two rocks averaging 5 by 8 inches were cast over 1,700 feet from the blast area of a quarry operated by Sunny Ridge Mining Company onto the Ward's property in McVeigh. The inspection report indicates that the flyrock incident occurred while the Wards were enjoying an outdoor 1st-year birthday party for their daughter Emily, and that "fragments of the rock actually hit Emily or another child." On August 16, 2000, flyrock from another quarry, also operated by Sunny Ridge Mining Company, was cast onto residences in Henroost Fork of Feds Creek.
  https://www.kyrc.org/news/archive/a-letter--relating-to-sunny-ridge-mining-company.

### Flyrock 33

- On February 8, 1999, blasting at a quarry near Kyusyu, Japan, hurled flyrock nearly 300 metres from the blast site causing personal injury and property damage.

> *Human Damage: A piece of rock crashed through the front glass of a car and then it hit and rebounded upon a driver's door and fell on the right thigh of an employee…operating the car. The degree of injury of the person was a thigh concussion with the complete recovery ten* days.

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[195] Catch Article: Red Hill blasting nets fine, February 5, 2008, http://www.hamiltoncatch.org/view_article.php?id=247&utm_source=CastonguayNewsletterNov&utm_medium=email&utm_campaign=Castonguay.

> Physical damage: The front glass and the inner globe of the driver's door suffer[ed] the damage by a *piece of rock. And another piece of rock damaged…[the] roof on the factory building. An opening (nearly 4 cm) with crazing [cracks]…on the slate roof.*

http://www.jes.or.jp/mag/stem/Vol.65/documents/Vol.65,No.6,p.206-214.pdf.

### Flyrock 34

- On June 4, 1993, **reckless blasting at a surface coal mine near a highway caused a significant amount of flyrock, some of which struck and killed a teenage passenger in a car travelling along the highway**.

> *In June 1993, a Tennessee coal mining company was blasting to loosen overburden at its surface mine. The mine was located immediately adjacent to the right-of-way of the northbound lane of Interstate 75. The approved permit included special precautions to be taken when blasting in the area closest to the interstate, including monitoring traffic so as to blast when the northbound lane was clear.*
>
> ***On June 4, 1993, the company detonated a blast in an area less than 300 feet from northbound interstate traffic, and failed to monitor traffic. This blast created a large amount of flyrock, some of which struck a car traveling north on Interstate 75. A 16-year old boy, a passenger in a car driven by his parents, was killed as a result of the flyrock impact.*** [emphasis added]
>
> ***The investigation by the federal Office of Surface Mining Reclamation and Enforcement identified causes of the fatality, including the company's failure to adhere to safe blasting practices and failure to implement safety measures required in the permit.*** [emphasis added]
>
> ***The U.S. Department of Justice prosecuted three individuals--the certified blaster, the day shift superintendent, and the mine manager for violations of 30 U.S.C. § 1268(e) and (f). The certified blaster and the superintendent pled guilty to a misdemeanor count of a willful and knowing violation of a permit. The mine manager was acquitted after a trial. The certified blaster was given a ten-month sentence and the superintendent was given an eight-month sentence. The company went out of business within four months of this blasting incident.*** [emphasis added]

https://www.osmre.gov/resources/blasting/docs/Flyrock/1993SugarRidgeFatality.pdf.

### Flyrock 35

- In 1991, a granite quarry in Virginia set off a blast that generated flyrock causing major damage to two homes, a garage, boat, basketball goal, along with other damage. The impacted neighbourhood was approximately 2,000 feet (610 metres) from the location of the blast, and people were close-by. A rock weighing about 17 pounds had gone through the wall of one house causing considerable damage to the wall and furniture inside. The second residence had a rock go through the outer brick wall and lodge in the inside wall. The picture window was broken, an inside wall, and the bookcase sitting against it were damaged, with litter around the room from the bookcase. Another rock had gone through the garage and exited through the opposite end of the building, causing considerable damage. Those responsible for investigating the flyrock incident were of the opinion that there was a weakness in the burden between the face and shot holes (p. A6-7).
  https://www.dmme.virginia.gov/DMM/pdf/TRAINING/SBGuide.pdf.

### Flyrock 36

- On July 11, 1990, **flyrock from a Livingston County, IL limestone quarry blast traveled about 930 feet (283 metres) and struck a resident who was mowing grass on his property. He died from head injuries on July 17, 1990**. [Mine Safety and Health Administration, Department of Labor 1990B]
  https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/sofad.pdf.

### Flyrock 37

- On November 3, 1989, a limestone quarry in Virginia set off a blast that generated flyrock and excessive airblast. **Twenty-three homes were damaged. Three of the homes suffered structural damage from flyrock, and two homes had their windows broken. The airblast was in excess of 145 decibels**. An investigation concluded that "the weakness/cavities in the geological structure of the formation/rock to be shot and the failure to recognize this potential led to this incident occurring [p. A8]."
  https://www.dmme.virginia.gov/DMM/pdf/TRAINING/SBGuide.pdf.

# *SECTION III – BLASTING CASE STUDIES*

Blasting is an ultrahazardous, abnormally dangerous activity. It has been identified as "intrinsically dangerous," because of the impossibility of "predicting with certainty the extent or severity of resulting consequences" rendering blasting ultrahazardous.[196] Ultrahazardous activities are also known as "abnormally dangerous" activities. No amount of reasonable care can "eliminate the risk of serious harm" accompanying an ultrahazardous activity such as blasting.[197] Accordingly, courts have held that a rule of strict liability applies to actionable harms resulting from blasting.

> *Because these activities [blasting] are extremely dangerous, they must "pay their own way, [citation omitted] and the parties responsible must bear the cost regardless of whether they have been negligent. North Carolina courts have not yet recognized as ultrahazardous any activities other than blasting [para. 234].*[198]

*Strict liability* does not require proof of negligence: [199]

> *Strict liability is a legal doctrine that holds a party responsible for their actions or products, without the plaintiff having to prove negligence or fault. When someone partakes in ultrahazardous activities such as keeping wild animals, using explosives, or making defective products, then they may be held liable if someone else is injured.*
>
> *Even if the defendant took necessary precautions and followed safety requirements, strict liability crimes are unique in that they would still hold the defendant responsible. Due to the nature of the activity, the defendant should be able to foresee that a person could be harmed by it.*

## Case Study 1 (Exercise of Due Care Cannot Eliminate Dangers Associated with Blasting)

In *Dyer*,[200] the appellate court noted that blasting is "inherently dangerous" and that "most courts have recognized that this inherent danger cannot be eliminated by the exercise of care." The courts have allowed strict liability in blasting cases because of the unpredictability of the danger associated with even the most cautious blasting. (Worley, 210 S.E.2d at 163) In support of this assertion, the court demonstrated that "Dyers' expert testified that blasting may cause damage even when it is within the [United States Bureau of Mines] guidelines."

> ***The court further justified imposing strict liability by contending that "although blasting is a lawful and often beneficial activity, the costs should fall on those who benefit from the blasting, rather than on an unfortunate neighbor."*** [emphasis added]

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[196] *Guilford Realty & Insurance Co. v. Blythe Bros. Co.*, 131 S.E.2d 900 (1963) 260 N.C. 69. See also *Humphrey Land Investment Co. v. Resco Prods.*, 19-76 (N.C. Ct. App. 2019) for a discussion of "strict liability" applied to actionable harms proximately caused by blasting. https://scholar.google.com/scholar_case?case=15464038202938224374&q=flyrock&hl=en&scisbd=2&as_sdt=2006.

[197] See *Woodson v. Rowland*, 407 S.E.2d 222 (1991) 329 N.C. 330, at 350, 407 S.E.2d at 234.

[198] Ibid.

[199] LegalMatch https://www.legalmatch.com/law-library/article/what-is-a-strict-liability-tort.html.

[200] *Dyer v. Maine Drilling and Blasting, Inc.*, 63 Me. Rev. 331 (2010). See "The Wrong Approach at the Wrong Time?": Maine Adopts Strict Liability for Abnormally Dangerous Activities

In order to prevail on an ultrahazardous or abnormally dangerous claim, the plaintiff needs to prove all of the following elements:[201]

- *The activity involves a verifiable risk of serious harm to persons or property*
- *The activity cannot be performed without the risk of serious harm, no matter how much care is taken, and*
- *The activity is not commonly engaged in by the people of the community*

*Also, it must be proven that the defendant's actions actually caused the plaintiffs' injuries, and that the plaintiff did in fact sustain injury.*

### Case Study 2 (Strict Liability for Property Damage Caused by Quarry Blasting)

Prior to the 1969 ruling in *Spano v. Perini Corp.*, for a person in the State of New York to succeed on a claim for damages caused by blasting there had to be a showing of negligence on the part of the blaster, unless the blast was accompanied by an actual physical invasion of the damaged property. For example, a physical invasion by rocks or other materials cast upon premises from a nearby blast. *Spano*, one of the plaintiffs, owned a garage which he alleged was wrecked ("cracked in the wall…the window broke, and the cement floor all pop up") by concussion from a blast on November 27, 1962, consisting of 194 sticks of dynamite, occurring at a construction site 125 feet from the damaged premises. Davis, the second plaintiff, whose car was in the garage for repair at the time of the blast, claimed that the blast had damaged his car. At the bench trial, although the plaintiffs did not pursue a claim of negligence, judgments were rendered in their favour, with the court awarding *Spano* $4,400 and Davis $329. On appeal, a divided Appellate Term reversed the judgment, declaring that it was bound by the established rule in *Booth*[202] requiring proof of negligence. The dissent urged that the *Booth* case of 1893 should no longer be considered controlling precedent. The Appellate Term reversal was affirmed by the Appellate Division. The Appellate Division called attention to a decision of the Third Department (*Thomas v. Hendrickson Bros.*, 30 A D 2d 730, 731), in which the court observed that "[i]f *Booth* is to be overruled, `the announcement thereof should come from the authoritative source and not in the form of interpretation or prediction by an intermediate appellate court'":

> ***In our view, the time has come for this court to make that "announcement" and declare that one who engages in blasting must assume responsibility, and be liable without fault, for any injury he causes to neighboring property***. [emphasis added]

On the issue of strict liability, the Appellate Division went on to acknowledge that,

> ***The concept of absolute liability in blasting cases is hardly a novel one. The overwhelming majority of American jurisdictions have adopted such a rule. (See Prosser, Torts [2d ed.], § 59, p. 336; 3 Restatement, Torts, §§ 519, 520, comment e; Ann., 20 ALR 2d 1372.)***[203] [emphasis added]

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[201] LegalMatch, https://www.legalmatch.com/law-library/article/ultrahazardous-activity-liability.html. See *Restatement (Third) of Torts* § 20(b) (2009). A person who is found by a court to have carried on an abnormally dangerous activity will be subject to **strict liability** for physical harm resulting from that activity.

[202] *Booth v. Rome, W. & O.T.R.T. Co.* 140 N.Y. 267 (1983) 35 N.E. 592.

[203] See, e.g., *Exner v. Sherman Power Constr. Co.*, 54 F.2d 510 (2d Cir.); *Colton v. Onderdonk*, 69 Cal. 155; *Whitman Hotel Corp. v. Elliot & Watrous Eng. Co.*, 137 Conn. 562; *FitzSimons & Connell Co. v. Braun*, 199 Ill. 390; *Louden v. City of Cincinnati*, 90 Ohio St. 144; *Hickey v. McCabe & Bihler*, 30 R. I. 346.

### Case Study 3 (Quarry Blasting – Property Damage Caused by Flyrock)

Offences under the *Occupational Health and Safety Act*, R.S.Y., 2002, c. 159, are strict liability. On November 1, 2007, an explosive charge set off by P.S. Sidhu Trucking Ltd.[204] on the Hamilton Boulevard Extension in the City of Whitehorse sent a piece of flyrock, the size of the owner's fist, through the roof of Trailer #23 and landed on the living room floor. Trailer #23 is located in Lobird Trailer Court approximately 350 metres from the blast site (para. 7). Again on May 6, 2008, a blast scattered flyrock along the road leading to the trailers in nearby Lobird Trailer Court. One rock flew 166 metres from the blast site and penetrated the roof of Trailer #212 and ended up in the living room, nearly hitting the occupants. Trailer #112 and Trailer #218, 219 metres and 149 metres, respectively, from the blast site were also damaged. None of the occupants had been notified of the blast. Other flyrock hit roads, fences, sheds, vehicles and trailers. At trial court, the expert testified that, but for the flyrock incident, the blast was a 98% success (para. 50)!

> ***An expert blaster called by counsel for the Director of Occupational Health and Safety indicated that blasting is not an exact science, and he appeared unwilling to blame the blaster. Had it not been for the flyrock incident, he testified that he would have considered the blast a success (para. 23). [The expert] did acknowledge that there was zero tolerance for flyrock in urban settings (para. 24) [but said] he might have made the same decisions as the blaster (para. 25).*** [emphasis added]

The lower court ruled that the *OHS Act* is to promote safe practices in the workplace, protecting employees, and members of the public that are in proximity to the workplace. The damage from the blasting incident was foreseeable. Both the blaster and the expert acknowledged that blasting is inherently dangerous. The court's ruling, upheld on appeal, concluded that Sidhu Trucking did not exercise due diligence and failed as an employer to ensure that blasting processes under its control were safe and without risks to health (para. 75).

Richard Scott Parker, testifying in the trial court as an explosives expert with 40 years' experience, was quoted in a March 31, 2010 article,[205] stating that,

> ***No one can do a perfect blast every time. That's why blasting companies carry insurance***.[emphasis added]

### Case Study 4 (Quarry Blasting – Concussion and Vibration Caused Property Damage)

As a result of blasting operations at the Vigus Quarry, the plaintiffs in *Donnell v. Vigus Quarries*[206] were awarded $27,000 for damages caused to their property by *concussion* and *vibration*. In 1966, the plaintiff commenced construction of a barn. At that time there was no blasting at the quarry adjoining their property. In 1967, the Donnells noticed some blasting at the quarry. Concerned over the effect blasting might have on a home that the

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[204] *Director of Occupational Health and Safety v. Government of Yukon, William R. Cratty and P.S. Sidhu Trucking Ltd*., 2012 YKSC 47 (CanLII), <http://canlii.ca/t/fs6vt>, retrieved on 2019-09-28.

[205] "Blasting is not an exact science': expert," *Whitehorse Daily Star*, https://www.whitehorsestar.com/News/blasting-is-not-an-exact-science-expert.

[206] *Donnell v. Vigus Quarries, Inc.*, 526 S.W.2d 314 (1975). https://scholar.google.com/scholar_case?case=11912900217179761342&q=Donnell+v.+Vigus+Quarries+Inc&hl=en&as_sdt=2006.

Donnells were planning to construct, a representative of the quarry was contacted. The quarry representative assured the Donnells that there would be no blast damage to structures on their property, which was about a quarter mile from the quarry. Construction of the home was completed in 1969, and the Donnells moved in the same year. In addition to the barn and house, they built a workshop and a pavilion. In late 1969 or 1970 after experiencing vibrations from blasting, the Donnells observed that the front and rear porches had cracked. On further inspection of the home, and other structures on the property, additional cracks were found in the house, barn, pavilion and workshop. Most of the cracks appeared in the fireplaces, the ceilings, basement and floors of the new buildings.

Joseph Brooks, a consulting engineer with a masters degree in civil engineering, was retained by the Donnells. He testified that the home was above average in construction, and that the other buildings on the property were of typical construction. The home is on a rise and the home and other structures are built on hard clay with no fill. Accordingly, drainage settlements and differential settlement were ruled out as causes of the cracking and damages to the structures. Brooks inspected the property in April 1972 and again in February 1973. In response to a hypothetical question, Brooks testified that the damage to the plaintiffs' property was caused by blasting operations. While acknowledging that blasting may be lawfully pursued, the court held that when explosives are intentionally detonated there is absolute liability for injuries and damages.

> *Preliminarily we note that blasting is a work which may be lawfully pursued. However, when one intentionally detonates explosives he is absolutely liable for injuries and damages which are the proximate result of such explosions. Summers v. Tavern Rock Sand Company, 315 S.W.2d 201 (Mo. 1958).*

The court was sensitive to the fact that "in cases such as this *vibrations* and *concussions* cannot be seen, and the case must, to a large extent be based on circumstantial evidence [citation omitted]." Damages to property in cases of explosion are measured as the difference in market value *before* and *after* the blasting operation or the cost of restoring the property, whichever is the lesser. A local real estate broker testified on behalf of the Donnells, without objection, that prior to the blast damage the value of the property was $90,000, and because of the blasting the value of the property had decreased by $35,000. The trial court awarded $27,000 in damages, which was upheld by the appeals court.

### Case Study 5 (Quarry Blasting Caused Damage to 12 Neighbouring Residences)

In *Cass Company-Contractors v. Colton*,[207] plaintiffs representing 12 separate claims filed suit against the owner of the quarry for damages to their respective houses allegedly caused by the wrongful and negligent discharge of large quantities of high explosives during 1951 and 1952, and in particular an explosion on October 6, 1951, from the quarry located one-half mile (805 metres) away. In a case of first impression, the question of damages resulting from blasting vibrations or concussions had not been addressed by the appeals court in Colorado. On this issue, the appeals court canvassed the rulings of other jurisdictions, and came to the conclusion that absolute liability appears to be the majority rule.

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[207] *Cass Company-Contractors v. Colton*, 279 P.2d 415, 130 Colo. 593 – Colo. Supreme Court, 1955.

> *Authorities from other jurisdictions are divided, some courts resting their opinions on the theory that to be liable for damages from blasting the operator must be shown to have been negligent; others that there must be shown facts and circumstances of the blasting from which negligence may be presumed, or which bring the case under the doctrine of res ipsa loquitur; others that the blasting operation must be shown to constitute a nuisance; and still others, that blasting is an inherently, dangerous operation in which the operator engages at his peril, making him an insurer liable for direct, as well as consequential, injuries therefrom. Whitman Hotel Corp. v. Elliott & Watrous Engineering Co., 137 Conn. 562, 79 A.2d 591, 594-595; Brown v. L. S. Lunder Const. Co., 240 Wis. 122, 2 N.W.2d 859; Pope v. Edward M. Rude Carrier Corp., W.Va., 75 S.E.2d 584, 594-595. This last theory of absolute liability appears to be the majority rule.*

The Colorado appeals court also cited an 1887 Colorado case that involved blasting and damage from falling rock, which it considered relevant:

> *"In general, if a voluntary act, lawful in itself, may naturally result in the injury of another, or the violation of his legal rights, the actor must at his peril see to it that such injury or such violation do[es] not follow, or he must expect to respond in damages therefor; and this is true, regardless of the motive or the degree of care with which the act is performed …[citing cases]. The company was bound at its peril to see that plaintiff's rights of property were not injuriously affected. In so far as these rights were interfered with by defendants' acts, such acts were wrongful; and, if the injuries complained of were the natural and proximate consequence thereof, plaintiff was entitled to recover."* [G. B. & L. Ry. Co. v. Eagles, 1887, 9 Colo. 544, 13 P. 696, 697]

The Colorado appeals court accepted the lower court's finding on the theory that blasting is an inherently dangerous operation, rendering the quarry operator absolutely liable for the damages to the plaintiffs' houses, and also on the theory that the quarry operator was negligent in the blasting, of which the plaintiffs complained. In upholding the lower court's ruling on these two claims, and finding that the quarry blasting and the quarry operator's negligence were the proximate cause of the damage to the plaintiffs' houses, the appeals court alluded to the following evidence:

> *There is evidence in the record that the blastings were inherently dangerous operations, and that injuries to nearby houses became apparent immediately thereafter. In such case, whether or not the blastings were the proximate cause of the injuries complained of may be determined…from the facts and circumstances of the case. Velotta v. Yampa Valley Coal Co., 63 Colo. 489, 167 P. 971, L.R.A.1918B, 917. The facts and circumstances in the record in the instant case are sufficient to sustain the findings that the blastings were the proximate cause of the injuries and damages sustained.*
>
> *On the question of negligence there is also evidence in the record sufficient to sustain the findings that defendant operator was guilty of negligence in failing to seek an appraisal of and foresee the natural consequences which might result from its blasting operations, especially in view of the prior remonstrances [plaintiffs' protests] and warnings of possible damages from the nearby house owners to officers of the defendant operator at a public meeting.*

### Case Study 6 (Blasting Caused Damage to Homeowners' Property)

In *Laughon Johnson v. Burch*,[208] the homeowners (Johnsons) sustained property damage from nearby blasting in connection with road work. Severe *vibration* and *concussion* from the blasting caused cracks to the exterior and interior of the plaintiffs' residences. At trial,

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[208] *Laughon Johnson v. Burch*, 278 S.E.2d 856 (1981). https://scholar.google.com/scholar_case?case=3814718433162417000&hl=en&as_sdt=2006.

> *plaintiffs conceded they had no evidence that defendant was negligent in either case. The plaintiffs' evidence showed that cracks developed in the interior and exterior of their homes following severe vibration and concussion associated with the blasting.*

The trial court ruled in favour of the homeowners applying the rule of strict liability, finding as a fact that the *concussion* from the defendant's blasting operation proximately caused the damages. On appeal, the Supreme Court of Virginia upheld the lower court's ruling. The court concluded that "when property is damaged by vibration or concussion from blasting operations, there will be liability upon the blaster irrespective of negligence, provided, of course, the damage claimed is a direct and proximate result of the explosion," quoting favourably from *Exner*:

> *It is true that some courts have distinguished between liability for a common-law trespass, occasioned by blasting, which projects rocks or debris upon the property or the person of the plaintiff, and liability for so-called consequential damages arising from concussion, and have denied liability for the latter where the blasting itself was conducted at a lawful time and place and with due care. [Citations omitted.] Yet in every practical sense there can be no difference between a blasting which projects rocks in such a way as to injure persons or property and a blasting which, by creating a sudden vacuum, shatters buildings or knocks down people. In each case, a force is applied by means of an element likely to do serious damage if it explodes. The distinction is based on historical differences between the actions of trespass and case and, in our opinion, is without logical basis. [54 F.2d at 513-14].*

### Case Study 7 (Quarry Blasting Damaged Homeowners' Residence and Truck Struck by Flyrock)

In *Peet v. Dolese & Shepard Co.,*[209] the homeowners (Peets) claimed for damages caused to their residence by blasting operations at the defendant's stone quarry. According to Chester Peet,

> *at approximately 4:00 or 4:30 p.m., on March 8, 1957, he was home; about 5:00 p.m. there was set off a blast at the stone quarry to loosen stone. It was noticeable and quite heavy. Plaster cracked. Dishes fell out of a cupboard….[H]e went to the basement where he noticed a vertical crack on the east wall. On the west wall there was a half inch opening. There were plaster cracks in the living room, and in the bedroom. He heard other blasting from 1957 to 1959; in March, 1958 there was heavy damage; on April 12, 1959, a large stone from a blast landed in his yard, hit his truck, and fine gravel hit the roof of his house; on March 19, 1958, more plaster was cracked in the kitchen and around the chimney from the basement to the top of the house; the cracks allegedly caused by the blasting of March 8, 1957 were not in the house prior to that time. The blast vibration shook the house, plaster chipped, there were finger sized cracks. His house is 800-1000 feet east of the quarry. The blast came in a northerly or westerly direction from the quarry. He stated that prior to March, 1957 he never had occasion to go down and examine the basement for cracks, there were no cracks in the basement from 1947 to 1957, and that he noticed immediately after the blast of March 8, 1957 the vertical crack in his basement wall. There were certain photographs of the basement walls in evidence. The rock that hit his truck in April, 1959 was in evidence….The basement walls were eight inch concrete blocks.*

A separate claim for damages to Chester Peet's truck caused by flyrock hurled a distance of 800-1,000 feet (244-305 metres) following blasting on April 12, 1959 at the quarry was settled privately by the defendant. Levon Seron, an architect, engineer, graduate of

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[209] *Peet v. Dolese & Shepard Co.*, 190 NE 2d 613: Appellate Court, 2nd Dist., 2nd Div. 1963. https://scholar.google.ca/scholar_case?case=3174132391603144 15&q=Peet+v.+Dolese+%26+Sheppard+Co.&hl=en&as_sdt=2006&as_vis=1.

Massachusetts Institute of Technology, and a real estate broker, testified on behalf of the plaintiffs as to the condition of the residence.

> *[Seron] viewed the premises in November, 1961 and examined the cracks and the general area of the home. He found the first floor plaster cracks, basement exterior walls cracks in the concrete block foundation on the interior and exterior, and cracks over the front door which were not straight but irregular. He described other cracks in the bedrooms, kitchen, etc. He said if blasting had occurred in close proximity such could cause certain of the cracks. The [trial] Court asked Seron the following questions:*
>
> > "Assuming that the blasting from Dolese and Shepard Company caused the damage in this house, would there be some force extended through the air or through the ground, or both, or from some other force, or what?"
>
> *and the witness answered:*
>
> > "I would say through the air and ground, it could be both. I would qualify my answer, and I don't know the size of the blast, what it was at the time, but if there was an overcharge of an enormous amount of dynamite, it could or can react in the air as well as the ground."
> >
> > [Seron] said if an explosive charge was properly placed and tested there could be or would be no damage.

Tim Lewellen, testifying on behalf of the defendant, described in detail the blasting protocols at the quarry, and despite taking every precaution, it was conceded that the use of dynamite is "tricky" and that there is no way to overcome human error.

> *Tim Lewellen…testified that the defendant used explosives on March 8, 1957; he determined the depth of the hole; the Atlas Powder Company loaded the shot under his direction; he did not personally load it; he observed the loading. On that date explosives were used at what is commonly called the south wall; this was 800-1000 feet from the plaintiffs' house; the total amount of dynamite used was 3,295 pounds in several holes, some at the depth of 76' and some at the depth of 81'. There was blasting May 6, May 12, May 29, 1958, — at 81 foot depths, — 2683 pounds of explosives on one occasion, — 3500 pounds on another, — 3166 pounds on another occasion. Those were 800-900 feet from the plaintiffs' residence. The explosives were gelatin and ammonium nitrate with nitroglycerin. He said some explosions bring down more rock than anticipated, but shock from an explosion would not do that.* ***When the piece of rock was blown over to the plaintiffs' lot that was from a little blast, it was not in their plan to send it 800 feet, and they had taken every precaution. He said dynamite is T.N.T., the expression dynamite is tricky, and it is possible for it to do the unexpected thing on occasions. He said he did not believe there is a way to escape human error.*** [emphasis added]

Jules E. Jenkins, an engineer specializing in seismological disturbance and the measurements of industrial noises, also appeared on behalf of the defendant, and testified that seismology is the science pertaining to the movement of earth.

> *When explosives are used in quarry operations there is a wave motion known as energy, travelling in the earth, and it can be determined by the seismograph….Force or energy so created follows the course of least resistance in the earth. In terms of quarry operations with embedded blasting the airborne effect of blasting is nothing so far as structural effect or damage to a building nearby is concerned. With regard to personal property, it will knock such loose from hangings. Those manifestations would have no effect on concrete foundations. The only possible effect on the foundation is through the earth; the air blast would have no effect on plaster in rooms. On December 19, 1956 and on September 6, 1960 he went to the Peet residence at the time test blastings were made and seismograph measurements thereof were made in their home, and he testified as to the details of those shots, and measurements, 4433 pounds of explosives being used one time, 3291 pounds another time, and 2783 pounds another time, and he said the first test measurement was rated as having 37% of force compared to 100% for damage, and the others*

> *were rated at 10% of allowable vibration limits….In one of the tests the explosive was at a 75 foot depth, and in the others at a 60 foot depth. All tests were made at or about noon. He said they were not extensive enough to do any damage to the structure.* ***The damage criterion is predicated on plaster. It is the building material which falls first. He further testified that no seismograph recordings were taken on March 8, 1957; he did not know what the defendant put in the blasting hole on March 8, 1957, or the amount of explosives. There were variables to take into consideration, — the shape of the explosive, the direction of the blast, the wind direction, the temperature, weather conditions, condition of the structure, location of the blasting hole, the force of the blast, and many others. He said the cracks in the Peet residence definitely could not have been due to embedded blasting. He said that transmission of the force of blasting to the Peet home had to go through the earth. He didn't know the variables involved here other than the distance of the house and the material by which the force was transmitted, and he said that it was necessary to take variables into consideration, and "any shot put up will have a certain amount of variables, come what may ... you will have variables with dynamite, you will have variances in the distances of rocks, with, if hard rock and spot soft, they are things that are natural parts of the business.*** *Within the working range of benches, I don't feel that they could by blast in that be enough energy in the ground to move that house at a distance of 800 feet."* [emphasis added]

As noted by the court, no matter the degree of care or skill exercised in the handling of explosives, there is always the prospect of property damage and injury (or death) to persons for which there is liability, provided there is a causal connection between the damage and the blasting operation.

> *One who makes use of an explosive in the ground near the property of another, when the natural and probable, though not inevitable, result of the explosion is injury to such property of the other, is liable for the resulting injury, however high a degree of care or skill may have been exercised in making use of the explosive;* ***it is a matter of common knowledge that the use of dynamite as an explosive is intrinsically dangerous; this includes consequential injury resulting from an explosion by reason of concussion or vibration, as well as an injury resulting from rock or debris, etc. being thrown upon or against the other property;*** *in a case where there is liability the proper measure of damages is the cost of repairing the building and restoring it to its proper condition as it was before it was damaged by the explosion: Fitzsimons etc. Co. v. Braun et al. (1902) 199 Ill. 390, 65 NE 249; Baker et al. v. S.A. Healy Co. et al. (1939), 302 Ill. App. 634, 24 NE2d 228; Opal et al. v. Material Service Corp. (1956), 9 Ill. App.2d 433, 133 NE2d 733.* ***It is not necessary that there have been negligence by the defendant. It is necessary that there be a causal connection between the alleged damage and the blasting operation. This is the majority view and is followed in Illinois.*** [emphasis added]

The trial court ruled in favour of the homeowners and awarded damages, and the appellate court upheld the lower court's judgment.

### Case Study 8 (Quarry Blasting Destroyed Homeowners' Well)

In *Arras v. Columbia Quarry Co.*,[210] the homeowners were awarded damages for the loss of water in a 165-feet-deep well on their property occasioned by blasting operations at the defendant's quarry, located approximately one-half mile (805 metres) away. The Arrases have lived on the property since 1948, and the well on the property has been working since sometime in the 1800s, and provided water for all their needs until August 31, 1972, the day of the quarry blast.

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[210] *Arras v. Columbia Quarry Co.*, 367 NE 2d 580 – Ill: Appellate Court, 5th Dist. 1977. https://scholar.google.ca/scholar_case?case=12491414116569650571&q=Arras+v.+Columbia&hl=en&as_sdt=2006&as_vis=1.

> *The plaintiffs testified that they were in their home on the afternoon of August 31, 1972….Mrs. Arras said that when she first felt the blast the house was vibrating, a cabinet door flew open and a cup fell out. She ran outside and could see the dust from the blast flying up. The blast, she said, was an especially heavy one.* ***She also stated that their well had been working properly that morning but after the blast there was no more water in it.*** [emphasis added]
>
> *Mr. Arras...said that the evening of the blast the pump was pumping and would not shut off. The next day he checked to see if anything was wrong with the mechanism but found it intact. He put it back and started it again but there still was no water.* ***He put a hose down the pipe alongside the wooden rod that pumps the water and ran water into the well. It immediately started to pump but nothing came up except sludge.*** [emphasis added]
>
> ***[A] neighbor of the Arrases[] testified that on August 31, 1972, about 3:30 p.m., there was a heavy blast*** *and the earth was shaking and a "big smoke came up."* ***She testified further that after the explosion the water in her well, which was 184 feet deep, disappeared and there was a crack in the foundation of her garage.*** [emphasis added]
>
> *[Another neighbor] testified that she was fishing in a pond on her property at the time of the explosion on August 31, 1972.* ***She said that she heard the noise from the blast and felt the ground shake. She then saw the smoke rising in the air and was hit by debris [flyrock] from the explosion*** [**emphasis added**]***…[****She] further testified that the water in her well, which was 200 feet deep, was muddy and she had to haul water in from elsewhere for a while after the explosion. She said that this happens when there are heavy blasts and that the water is usually clear again within 24 hours…****[She] said that after this blast her house had broken windows and cracks in the concrete.*** [emphasis added]

Dohrman testified on behalf of the homeowners concerning the cost of drilling a new well:

> *He stated that he had been in the business of well drilling and pump repair for 15 years. He said it would cost $10 per foot to drill a well and gave an estimate of $5223 based on a well depth of 425 feet. He testified that it would be necessary to drill 425 feet if not deeper to get to water on the Arrases' property. He said he had based his estimate on the depth of other wells in the neighborhood within a half-mile of the Arrases' property.*

A safety engineer from the Department of Mines and Minerals testified,

> *That the amount of explosives used by the quarry company on August 31, 1972, should not have caused any damage to the Arrases' home or well.*

Another witness, John Mathes, a geotechnical engineer, testified concerning water tables and how they may change:

> *He stated that natural changes in the subsurface conditions, which happen often, could have caused the loss of water in the well.*

The trial court awarded the homeowners damages of $9,700. On appeal, the homeowners' award was reduced to $5,223, consistent with the cost estimate provided by Dohrman for drilling a new well capable of reaching water at a much lower level below the surface of the ground.

## Case Study 9 (On-going Quarry Blasting Destabilized Shoreline of Condominium Association's South Lake)

*Gateway Estates Park Condominium Association*[211] manages a mobile home community of 220 homes and two vacant lots. The condominium association holds title to a number of common elements, including man-made South Lake that was excavated sometime before 1975 when the condominium was registered. In 2005, *SDI Quarry*, which operates the only mines at which blasting is conducted in close proximity to the community, began blasting at three mines near South Lake, no closer than 7,000 feet (2.13 kilometres) from the mobile home community, averaging about 20 blasts a year. Each blast was monitored and the vibrations recorded. All were within lawful levels established by state law (the limit is a particle velocity (PPV) of 0.5 inches per second). None exceeded 0.2 PPV at South Lake, with most being 0.1 PPV. No damage to South Lake was evident for five to six years of blasting until 2011, when its shore first began to show signs of destabilization.

> ***In 2011, about five or six years after Appellee began its blasting activities, the shore of the South Lake began to destabilize, and saturated soil at the edge of the lake began to slough and slump into the water. This opened up fissures in the slope, which undermined the upward bank. In time, holes appeared in the bank, and pieces of the once level surface fell off, resulting in a narrowing of the horizontal area from roughly five feet to about a foot and a half. Residents observed the ground falling into the water in close temporal proximity to the blasting.*** [emphasis added]

In late 2014 or early 2015, *Gateway Estates* retained James McNew, owner of Upper Keys Consulting, to give recommendations concerning restoration of the lake bank. Upper Keys Consulting prepared an estimate in the amount of $840,000 for restoring the shore of South Lake and installing preventive devices to protect the shoreline against erosion from further blasting. This led to litigation against *SDI Quarry* under Florida's Construction Materials Mining Activities Administrative Review Act. Blasting continued without interruption, and between July 1, 2015 and October 17, 2016, there were twenty-five blasts. Based on this figure, the administrative law judge inferred that the number of historical blasts that had impacted South Lake was 200 to 250. Whether the detonations caused harm to South Lake's shoreline was the focal point of the administrative proceedings.

> ***[That] the blasts were all within state standards…doesn't negate potential liability.*** [emphasis added]

It was acknowledged that "no generally accepted scientific standard exists as to relevant threshold PPV levels for when man-made lakeshores would be adversely affected by vibrations from afar." McNew, over the objections of the *SDI Quarry*, was qualified to testify "as an expert on causation." McNew, holding a degree in mechanical engineering, had no training or significant education in seismology, geotechnical engineering, or geology. McNew testified that he consulted extensively with an engineer, and they produced a set of notes based on their extensive research of the literature, and these formed the basis of his opinion as the causes of the slope stability failures around South Lake.

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[211] *SDI Quarry v. Gateway Estates Park Condominium Association*, 249 So.3d 1287 (2018), https://scholar.google.com/scholar_case?case=5383564357932576454&q=SDI+Quarry+v+Gateway+Estates&hl=en&as_sdt=2006.

> *McNew opined that vibrations from Appellant's blasting caused the problems at Appellee's lake. Specifically, he explained that these vibrations acted upon the soft layer of silt atop the shore and bank of the South Lake, causing the liquefaction of this saturated soil extending up to eight feet beneath the surface. This led to the compaction of the loose, wet soil around the edges of the lake, opening up cracks and holes and weakening the slope, which began to erode and fail. McNew conceded that there were no legal standards in Florida or elsewhere establishing thresholds above which lakeshore slope instability would be expected under the stress of blast-related vibrations. In formulating his opinion, McNew stated that he used Transit Authority Guidelines rather than mining guidelines because the transit guidelines provided a more realistic standard where the damages were not to buildings. McNew also ruled out other possible causes such as earthquakes or heavy truck hauling near the lake.*

Ruling in favour of *Gateway Estates*, the administrative law judge found McNew's opinion on causation more persuasive than the competing view offered by *SDI Quarry's* experts. In doing so, the judge

> *noted that Steven Black's categorical opinion that blasting could not be a cause of the damage to Appellee's lake was undercut by his concession that heavy truck traffic could affect the silt layer of a lakeshore over a continuous period of time. The administrative law judge also found that the circumstantial evidence supported McNew's opinion. Specifically, he noted that "the South Lake had existed for at least 35 years without experiencing the deterioration of the shore and bank that became noticeable within just five or six years after the start of the blasting, and which worsened over time as the blasting has continued." He also noted "the persuasive evidence that visible damage occurs in the wake of individual blasts."*

Black's evidence was accepted by the administrative law judge to the extent that wind, wave and rainwater was a natural cause of some of the bank erosion at South Lake, and found that *SDI Quarry's* blasting combined with the natural forces constituted a legal cause of the claimed property damages. Adding,

> *'as a matter of fact,' the property damage at issue is present and continuing; the harm to the lakeshore is cumulative, indivisible, and inseparable.*

Finding that blasting is an ultra-hazardous activity for which strict liability is imposed, the administrative law judge concluded that *Gateway Estates* was not required to prove *SDI Quarry* was negligent or that *SDI Quarry's* blasting was the sole cause of *Gateway Estates'* damage. *Gateway Estates* was awarded $840,000 in damages. In a continuing tort (trespass), the statute of limitations runs from the time of the last tortious act.[212] The Florida appeals court, in an unanimous ruling, upheld the administrative order.

In closing, the appeals court had this to say about the current state of debate about *causation* and *seismological liability-science*:

> ***Some people will deem it scientifically far-fetched to believe that lawful underground blasting in the range of 0.1 to 0.2 PPV over 1.25 miles away caused a man-made lake to gradually degrade over a decade for which $840,000 in compensation is owed; others will see it as entirely possible, and the damage award as a just result for an ultra-hazardous***

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[212] In *Plaunt v. Renfrew Power Generation Inc*., 2011 ONSC 4087 (CanLII) the reference to "The Law of Torts, 9th ed., John G. Fleming (Sydney: LBC Information Services, 1998), at page 48," that [i]n many American blasting cases it has been held that damage from flying rocks is trespass, but from vibration or concussion at most nuisance," no longer reflects the state of common law. Claims of damages occasioned by "vibration or concussion" as a consequence of blasting are now treated as the tort of "trespass."

> ***activity. Some will decry reliance on testimony by property owners that blasting was coincident with their damages, citing self-interest and bad science; others will applaud that such testimony and the administrative law judge's reliance on "common knowledge and ordinary experience" provide a necessary dose of reality to counter lifeless scientific data that lacks context. A skeptical few might go so far as to say that a Magic-8 Ball would be just as accurate in deciding causation, perhaps justifying greater scientific standards or a court-appointed expert to assist the judges. See, e.g., Rule 706, Fed. R. Evid. (2018) ("Court Appointed Expert Witnesses"). Such is the current state of debate about causation and seismological liability-science, which hasn't changed much in fifty years.*** [emphasis added]

### Case Study 10 (Quarry Blast – Homeowner's Well Damaged and Gone Dry)

In *Consbec Inc. v. Her Majesty the Queen*,[213] it was alleged that Sidon's well (a neighbouring residential property) had been damaged and gone dry, as a consequence of a blast on March 18, 2004 at Weeks' quarry. The same blast also propelled flyrock beyond the limits of the property. *Consbec*, the blasting company, was charged under the Environmental Protection Act for releasing a contaminant "flyrock" into the environment. On May 12, 2008, *Consbec* pleaded guilty to the offence before the trial Justice of the Peace, resulting in a fine and restitution order to replace the neighbour's well. Nine crown witnesses and one witness on behalf of *Consbec* appeared at the sentencing. Most of the evidence of the witnesses called to give testimony at the sentencing hearing, including two experts, Mr. Hawley for the prosecution and Mr. Jambakhsh for *Consbec*, was reviewed by the trial Justice of the Peace. *Consbec* presented no contrary evidence,

> *including, significantly, the lack of any pre-blast inspection of the Sidon's well, that "the water in the Sidon well prior to the blast in question was acceptable and usable, potable water".*

In favouring Mr. Hawley's evidence, the Justice of the Peace also noted Mr. Jambakhsh's lack of expertise in the construction and functioning of water wells:

> *His opinion that the blast was not sufficient to unseat the well casing from the bedrock was considered by the Court in the context of Mr. Jambakhsh's admitted lack of expertise in the construction and functioning of water wells.*

Despite the defendant's preliminary examination and challenge to the qualifications of the Crown's expert witness, Mr. Hawley was accepted by the trial Justice of the Peace "as an expert in well construction, well inspection and well water quality." The court also qualified Mr. Hawley "as an expert in well inferences including inferences from blasting based on his experience in resolving complaints of interference with well water quality or quantity during 57 investigations." According to Mr. Hawley,

> *In his opinion, he testified that the blast in question has shaken the local bed rock sufficiently to create two likely problems. First, the vibration was sufficient to re-suspend soils in the bedrock fractures supplying the Sidon well and second, the seal that existed between the casing and the bedrock has been broken by the vibration. This would account for the re-occurrence of the cloudy water following a rainfall event and could explain the bacterial contamination of the well.*

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[213] *Ontario (Ministry of the Environment) v. Consbec Inc.,* 2013 ONCJ 258 (CanLII), <http://canlii.ca/t/fxflx>, retrieved on 2020-04-18.

## Case Study 11 (Flyrock – Wrongful Death Suit)

In *Ramsburg v. Target Stores*,[214] the estate of Frederick Ramsburg, filed a wrongful death action against *Target Stores* in connection with an explosives blasting incident at a site being excavated by Faulconer Construction Company for the construction of The Target MidAtlantic Distribution Center. Mr. Ramsburg was not an employee of the company that conducted the blasting at the construction site, and did not come under the jurisdiction of the Virginia Workers' Compensation Act.

> *Frederick Ramsburg, was fatally injured on December 8, 1995 when he was struck in the head by flyrock [a 10- to 15-pound rock][215] from explosives' blasting conducted at a Stuart's Draft, Virginia construction site. Mr. Ramsburg died the next day, the proximate cause of which was the head injury.*[216]
>
> *Mr. Ramsburg was working on the Target Project property itself when he was fatally injured; he stood adjacent to, but not in, the immediate blasting area. At the time Mr. Ramsburg was struck by the blasting debris, he stood outside the five hundred foot, curiously-named "safety zone" perimeter within which flyrock posed a known danger.*

Mr. Ramsburg, a concrete inspector for a sub-contractor on the construction site, thought he was safe from flyrock at the distance he stood from the blasting activity.

> ***…[W]hen Mr. Ramsburg was fatally struck in the head with blasting flyrock, he stood outside five hundred foot "zone of danger" within which blasting flyrock was a known danger and beyond which Mr. Ramsburg had been assured that flyrock posed no risk***. [emphasis added]

On the claim of strict liability, the District Court granted summary judgment to Mr. Ramburg's estate. As noted by the court,

> ***Strict liability, or liability without fault, is premised on the reality that certain activities remain "abnormally dangerous" even though the person carrying on those activities exercises the "utmost care" to prevent harm to others. See Restatement (Second) of Torts § 519 (1976). The location of a person or property proximately injured by such inherently dangerous activity does not change the justification for a liability regime in which considerations of relative degrees of fault is immaterial. Indeed, as one court has stated, "[T]he basis of [strict] liability is the creation of an abnormal risk. This risk can be present both on and off [a] defendant's premises****. [emphasis added]" McLane v. Northwest Natural Gas Co., 255 Or. 324, 467 P.2d 635, 639-40 (1970). The court continued, anticipating the potentially curious result of Dayton's proposed strict liability regime entirely dependant [sic] on the fortuity of property lines:*
>
> > **[m]ere proximity to the area of danger may or may not be greater in the case of one who is on the premises as compared with one who is not. A person who is off the premises may be only across the street from the explosion while a person on defendant's premises may be a half mile away from it. No relevant distinction which is applicable in all instances is discernible between a person who is one foot within the boundary of defendant's premises as compared with one who is one foot from defendant's premises**. [emphasis added]

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[214] *Ramsburg v. Target Stores, Inc.*, 982 F. Supp. 1194 (1997), https://www.leagle.com/decision/19972176982fsupp119412021.

[215] T.R. Rehak et al, Flyrock Issues in Blasting, "A 10 to 15-pound rock propelled by the blast struck the worker who was then taken to an Intensive Care Unit via helicopter. He died the next day after undergoing surgery. Other workers said he ran for cover and was behind a van when the rock struck him, piercing his hard hat. [The Richmond Times Dispatch, Richmond, VA],", file:///C:/Users/Windows%207%20PC/Downloads/cdc_9755_DS1%20(2).pdf.

[216] Defendants do not contest the proximate causation issue.

The defendant's defense of *assumption of risk* dismissed by the Trial judge in rather blunt language was also upheld by the District Court:

> ***…[T]his Court has difficulty in even believing that the defense of assumption of risk can be asserted in this particular case because Mr. Ramsburg had a choice of either getting away and not performing his duties or being there and performing his duties and getting killed and I don't believe the law would make him decide between the two.*** [emphasis added]

## Case Study 12 (Cumulative Effects of On-going Blasting & Incidents of Flyrock Damaged Homeowners' Residences)

In *Cage Brothers v. McCormack*,[217] four homeowners alleged damages to their houses as a result of blasting operations conducted by the owner of a limestone quarry 700 feet (213 metres) to 1,200 feet (366 metres) from their homes. The homeowners were also subjected to Flyrock from the quarry blasting, and in one incident flyrock weighing 85 pounds was projected 730 feet (223 metres). In a jury trial, a judgment was entered in favour of the homeowners on their claim for damages, a ruling that was upheld on appeal, as there was

> *some evidence offered by the plaintiffs which would reasonably sustain a judgment in their favor, without the aid of the rule of res ipsa loquitor [a doctrine that infers negligence from the very nature of an accident or injury in the absence of direct evidence]…*

The extent of the damages caused by the quarry blasting to the homeowners' houses are described as follows, and according to the homeowners' expert, Dr. Tonn, repeated blasting has a cumulative effect of causing cracks from initial blasts to widen or worsen, even if subsequent blasts are of a lesser intensity:

> *The plaintiffs testified that simultaneously with the explosions in the defendant's caliche pit, which is between 700 and 1200 feet from the plaintiffs' premises, the `whole premises' were shaken, cracks appeared in the walls, chimney and fireplace of their home, objects were shaken out of a cabinet to the floor, a wall `buckled out,' 'large pieces of rocks' fell off the rock walls of the home, a rock fell out of the wall of the garage, almost striking Mr. McKay, and `a fairly good size rock' fell from the fireplace. Following these explosions, doors stuck which had formerly opened and closed properly, part of a wooden door `pulled apart,' and floors sagged and were weakened so that furniture shakes as the plaintiffs walk across the living room and dining room. Also, after blasts in the defendant's pit, the garage pulled away from the house; the corners of the downstairs rooms pulled apart; a big crack appeared in the concrete porch; water in the wells became clouded the butane gas line burst and a plumbing connection in the bathroom was broken. Other persons owning property near the caliche pit testified to similar effects from the explosions upon their houses.*
>
> ***The evidence here shows that this was not an isolated case of blasting but daily blasting, over a period of about six months in a hard limestone quarry. That these daily blastings were tremendous explosions causing great tremors and shaking. That as a result of such blastings dishes would rattle in the cupboards, and tools would fall off the wall in workhouses. Rock would be hurled great distances. One rock weighing 85 pounds was found 730 feet from the nearest ledge of the quarry, and it was still warm from the blasting. There were no cracks in appellee's houses before the blastings, but when the blasting started cracks began to appear in their walls. Appellees' houses were built, on concrete foundations, were well constructed of rock, rock veneer or brick veneer…One disinterested witness said that he was seated on a concrete porch at the home of one of appellees when a***

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[217] *Cage Brothers v. McCormack et al.*, 344 SW 2d (1961), https://scholar.google.ca/scholar_case?case=10141646206778100249&q=%E2%80%9Cblasting+damage%E2%80%9D&hl=en&as_sdt=2006.

***blast went off in the quarry, and it seemed to him that it bounced him one or two inches up off the concrete porch. Mrs. McCormick testified that she was on her back porch, of concrete construction, sweeping, when a blast went off in the quarry, and the porch cracked open almost before her eyes, and after each blast it got bigger….There were several disinterested witnesses who testified of the great concussions, shakings, quiverings and tremors every time a blast went off in the quarry.*** [emphasis added]

***Dr. Tonn….stated there are two things you are interested in beginning a quarry operation, one is the location of the blasting and the proximity of buildings or anything else that might suffer from blasting….Blasting sets up wave vibrations in the ground which represent displacement, and they are what cause damage at various point[s] from the blasting. They travel less distance in soft ground and further in rock or hard formations. He personally inspected the pit in question, which he said had a dense light brown limestone and a limestone materi[al] of bluish nature. The bluish material is hard and fairly dense limestone and is pretty hard.*** It is located in the balcones fault. In blasting you try to break the material up so that it can go in a rock crusher. [emphasis added]

***He had considerable experience in determining sett[l]ing cracks as opposed to explosions, and had checked some 800 houses that had settled, within the last year, and stated that they are character[i]stically different….Dr. Tonn testified in detail to the damages to appellees' houses, and that they were all from blast damage, and the magnitude was such that the vibration had to be excessive. In speaking of the effect of repeated daily blasting and its effect on a house once it is cracked, he said that it is accumulative and keeps getting worse, and the same force is not required to widen or make the cracks worse, and they will widen. In answer to a long hypotherical question embodying the testimony of the various witnesses concerning the blasting, vibrations, etc., he stated that in his opinion "the proof is in the pudding." It was blast damage.*** [emphasis added]

## Case Study 13 (Blasting – Building Damage and Loss of Livestock, and Punitive Damages)

In *Rotert v. Peabody Coal Company*,[218] the blasting damages and punitive damages awarded to the homeowners (John and Elizabeth Rotert) by the trial court were appealed by the mining company. The judgment consisted of $31,400 in actual damages and $32,000 in punitive damages. The Roterts' dwelling and 10-acre pig farm is adjacent to the strip coal mining operation. The mining company did not contest the evidence of damage sustained by the Roterts, but argued that the amounts awarded are "excessive and so excessive as to show bias and prejudice on the part of the jury." Appellant's suggestion "that the blind condition of John Rotert during the five days of trial caused the courtroom to be overcharged with emotion" was rejected by the appellate court. A summary of the Counts are as follows:

- Count l (willful, wanton and malicious conduct as the mining company used high explosives indiscriminately and caused great noise, vibrations of earth, air concussion and shock waves, creating noxious fumes, odor, dust and smoke and damaged respondents' property and persons)
- Count ll (Damage to Buildings): $8,000
- Count lll (Loss of 400 Pigs from E. Coli scours bacteria): $3,000

[218] *Rotert v. Peabody Coal Company*, 513 S.W.2d 667 (1974), file:///C:/Users/Windows%207%20PC/Documents/Rotert%20v.%20Peabody%20Coal%20Company,%20513%20SW%202d%20667%20-%20Mo_%20Court%20of%20Appeals%201974%20-%20Google%20Scholar%20Blasting%20Damage%20&%20Nuisance.html.

- Count lV (Elizabeth - Emotional Distress & Illness): $4,500 actual and $9,500 distress
- Count V (John): $5,000 actual damages and $22,500 punitive damages for loss of Elizabeth's consortium and for her medical expenses
- Count Vl (John - Nuisance): $500 for fumes and dust
- Count Vll (Deep Pit left across the road from respondents' home): $10,000

At trial, the homeowners related the following chronology of the prolonged blasting occurrences in support of their claims against the mining company:

> *Respondents first noticed appellant's blasting operation in 1968 at which time they talked to Shorty Powell, appellant's land man, about possible damage to their well. Later, as the mining operation moved closer, respondents noticed cracks appearing in the living and dining rooms of their home and Powell told them not to do anything to their home for 3 years. The mining operation continued toward their home, and blasting was occurring any time of the day or night, and Elizabeth started keeping a calendar log of some of the times the blasting was done, and of the severity of the explosions. She noted on the calendar dates the times of the explosions and their intensity, e. g., "hard", "very hard", "hardest yet" and "very, very hard." By months, the calendar describes these explosions, which when related to appellant's map showing dates and distances from appellant's property line to the trenches (computing distance by the map scale of 100 feet to the inch) show this approximate information: July, 1969, 4 explosions, when the strip was about 2,000 feet away; August 1969, 14 explosions, one hard, 1,850 feet away; September 1969, 6 explosions, 1,700 feet away; October 1969, 13 explosions, 3 very hard, 1,550 feet away; November 1969, 33 explosions, 1 hard, 6 "big shots", 1,450 feet away; December 1969, 34 explosions, 1,300 feet away; January 1970, 63 explosions, 10 hard, 2 very hard, 1,150 feet away; February 1970, 97 explosions, 15 hard, 20 very hard, 1,000 feet away; March 1970, 47 explosions, 15 hard, 13 very hard, 850 feet away; April 1970, 48 explosions, 16 hard, 9 very hard, 1 "hardest yet", 750 feet away; May 1970, 96 explosions, 2 hard, 47 very hard, 3 very, very hard, 600 feet away; June 1970, 87 explosions, 14 very hard; and on June 6, 1970, 3 very hard shots, and rocks fell from respondents' basement wall, 500 feet away; July 1970 (during which respondents were away for 9 days), 73 explosions, 23 hard, 10 very hard, 450 feet away; August 1970 (during which respondents were away 3 days), 37 explosions, 16 hard, 7 very hard, 350 feet away; September 1970, 85 explosions, 24 hard, 3 very hard, 300 feet away; October 1970, 66 explosions, 24 hard, 1 very hard —apparently about 1,000 feet to the northeast of appellant's property line in front of respondents' dwelling; on November 28, 1970, 3 days after suit was filed, there were 3 hard shots, about 250 feet from appellant's property line. Appellant stopped mining when it was 175 feet from its property line when ordinarily it would go to within 50 feet of the line. To the above distances, there should be added 125 to 175 feet, as the evidence variously shows, from the property line to respondents' dwelling.* ***By Elizabeth's log on the calendar there were more than 800 explosions from July 1969, through December 1970****, after which she got to the place where she could no longer keep the log.* [emphasis added]

> ***Elizabeth…made more than a hundred calls to…[employees at the mine] about the blasting as it got closer****. They did not cut down on the shots until after she called appellant's president in St. Louis at his home at 12:30 a. m., on March 1, 1970, but even after that call there was really no change in the blasting being done. Upon complaint, Reddick would merely respond, "Okay, I will tell them," (according to Elizabeth, Reddick showed a terribly lot of indifference to respondents' problem) and Powell would say, "Those shots aren't that hard," and would argue that it was the humidity, not the shot. Never did they give respondents an answer that indicated appellant was going to do anything about the blasting, which got worse and worse as appellant got closer to respondents' home. Prior to the time suit was filed, there was no notice to respondents that there was going to be blasting, but sometimes they would hear the warning whistle in the pit.* [emphasis added]

> *Elizabeth was awakened many times at night by the blasting, and the family was awakened and she would have trouble getting the children back to sleep.* ***She lost so much sleep that she "simply couldn't function any more"; she could hardly live with the blasting and became***

> ***crabby, nervous and jumpy as did John. She took medication, and developed a lot of epigastric distress and an ulcer for which she took Maalox and ate a bland diet. She was hospitalized two weeks. The medical testimony is omitted from the record at appellant's direction, and no issue is made as to the cause or extent of Elizabeth's physical condition, but it is conceded that she suffered no direct physical injury or contact from the blasting (other than from vibrations and concussions)***.[emphasis added]

Neighbours corroborated the relentless blasting conducted by the mining company, and the mining company's indifference to their complaints of vibrations to their homes (and contents), of exposure to unpleasant sulphur odour from highly acidic pits, and of frightened livestock (would get up and run).

The damage claimed by the Roterts to their residence was supported by the expert testimony of Dr. Fowler, who made a number of observations and conducted a variety of tests:

> *Dr. Frank C. Fowler, a consulting chemical engineer, observed the damage to respondents' premises, and gave his opinion that the same was caused by appellant's blasting operations. From tables he concluded as his opinion that suggested maximum values to avoid damage to a residence for explosives was 116 to 125 pounds for vertical holes as contrasted to appellant's use of 25 pounds per hold [sic] for as many as 24 vertical holes—the explosion of a total of 300 pounds at a distance of 500 feet. Another table showed a value at 500 feet of only 100 pounds of explosive; and if 300 pounds were used it would be more than double the recommended value and one would expect to find damage in a home such as respondents which Dr. Fowler inspected. It makes no difference in the (ground) vibrations whether holes are drilled vertically or horizontally, it is the amount of explosive which affects it. Dr. Fowler tested the accumulated water in appellant's pit across the road and found it to be very acidic. As to appellant's two seismographic tests, the evidence showed that the first was made 7,300 feet from respondents' home with the seismograph set up 2,100 feet from the hole that was exploded. The second was made 2,100 feet east of respondents' home but with the seismograph set up in respondents' front yard. Dr. Fowler would not have been satisfied with those tests. He would have needed more readings and different locations, "and closer up would be helpful, 600 or a thousand feet." He testified on cross-examination: "I wouldn't be satisfied if I was them with two tests and continued complaints. I wouldn't be satisfied with the result of that. Nor would I take the chance of going on." **The results of the tests (which respondents had never seen) were, according to appellant's witnesses, that at 2,100 feet the vibrations were 17% of enough to do damage, and at 2,000 feet (with the seismograph set up in respondents' yard), the vibrations were 11% of enough to do damage to a structure***. [emphasis added]

Except for the improper jury instructions on Counts ll and Vll, the remaining Counts (l, lll, lV, V & Vl) were unanimously confirmed by the appeals court. The instructions for a new trial on Counts ll and Vll are as follows:

> *The separate damage instructions should be framed under MAI 4.02 as to Count II, and under MAI 9.02 for permanent nuisance under Count VII. To make it clear to the jury as to its options under the separate instructions, they should be prefaced with the words of this import: "If you find for plaintiffs under Count II, but not under Count VII, then you must award plaintiffs * * *"; and "If you find for plaintiffs under Count VII, but not under Count II, then you must award plaintiffs * * *." For error in giving Instructions Nos. 11 and 16, a new trial must be had upon the issues raised by respondents' Counts II and VII [para. 678].*

In respect of Count ll, damages are <u>not</u> measured by the cost of repairing the damage to the buildings, but rather by the <u>difference</u> in what a prospective purchaser would pay for the property in its *before-* and *after-condition*, as instructed by the appeals court:

*"If you find the issues in favor of the Plaintiffs under Count II, you must award Plaintiffs such sum as you believe is the difference between the fair market value of Plaintiffs' whole property immediately before the Defendant's blasting operations and the value of Plaintiffs' whole property immediately after such blasting operations, which difference in value is the direct result of the Defendant's blasting operations.—Not in MAI Based upon MAI 9.02 [para. 677]."*

## Case Study 14 (Repeated Quarry Blasting – Homeowner's Property Rendered Worthless and Living Conditions Unbearable)

In *Hanna v. Brady*,[219] the homeowner (Hanna) sued B.V. Hedrick Gravel and Sand Company (Hedrick) for damages caused by blasting and the nuisance created by the operation of a quarry across the street from the homeowner's residence, and sought punitive damages.

Plaintiff owns approximately one acre of land along a rural paved road in Anson County, upon which he constructed a residence in 1964. In 1968, B.V. Hedrick Gravel and Sand Company purchased a 30-acre tract of land across the street from plaintiff's property, and leased this property to the lessees, who are the husbands of Hedrick's stockholders. The lessees thereupon began a quarrying operation, specifically, mining gravel and sand, which entailed the blasting, crushing, loading and hauling of rock. Lessees hired Cumberland to do the blasting, which took place on numerous occasions since the quarry began operating in 1968. Lessees also entered into a lease with Dickerson on 30 November 1977, which instrument assigned certain stockpiled stone to Dickerson, in order that Dickerson could remove the stone during the three-year term of the lease [para. 24].

The homeowner presented evidence of the unbearable conditions endured as a consequence of the quarry operations primarily through his own testimony, which was corroborated by other witnesses.

*Plaintiff's evidence, largely presented through the testimony of plaintiff himself and corroborated by other witnesses, tended to show that blasting explosions in 1979, 1980, and 1981 damaged his house, and that the crushing, loading and hauling of rock during 1980 and 1981 went on as long as 18 to 19 hours a day, sometimes as late as eleven o'clock at night. Plaintiff's evidence also tended to show that the two most severe problems caused by the quarrying operation were noise and dust. Plaintiff testified that the level of noise, in part caused by the crushing of stone and "beepers" on the trucks, interfered with his enjoyment of a normal home life, namely, that he was either unable, or barely able, to carry on a conversation, speak over the telephone, or listen to television or radio. He testified that the dust pervaded his house: it settled on the furniture; it made the food served on the table inedible; it caused the air conditioner to malfunction; it forced him to replace clogged appliances; and it made breathing difficult and unpleasant. He testified that he only saw a wetting device used on Hedrick's property once. Besides the noise and dust, plaintiff stated that lights from the trucks flashed into the house at night, and that loose rock was thrown into his yard from the trucks.*

While acknowledging the existence of a quarry operation, the quarry operator's defense that it operated the quarry in compliance with applicable government standards was rejected by the trial court.

*Defendants did not deny the existence of a quarrying operation; rather, their evidence was designed to demonstrate that the noise and dust levels were moderate and in accordance with applicable government standards—in essence, that no nuisance was ever created. Defendants*

[219] *Hanna V. Brady*, 327 SE 2d 22 (1985) N.C. Ct. App., https://scholar.google.ca/scholar_case?case=14374630816441889017&q=damaged+quarry&hl=en&as_sdt=2006.

> *presented evidence that applicable regulations were followed in blasting and that notice had been given to the adjoining property owner; that noises were muffled by the blast; that spotters monitored flying rocks; that water sprayers were used to minimize the dust; that they had never been cited by any governmental agency for excessive dust; and that noise levels did not exceed the federal maximum.*

The trial court ruled in favour of the homeowner, and awarded $35,000, of which $20,000 represented the market value of the homeowner's property in 1978, rendered worthless at the time of trial as a consequence of on-going quarry operations. The balance of the award accounted for the loss of the normal use and enjoyment of the property.

The lower court's ruling was upheld on appeal, with the appellate court commenting as follows:

> ***The plaintiff's evidence tended to show inter alia, that in 1978, his property had a fair market value of $20,000, while at the time of trial it had no value. Plaintiff also put on detailed and ample evidence tending to show that the noise and dust from the quarrying operation affected plaintiff's normal use of his property and his enjoyment of daily life****. Upon reviewing the evidence, we cannot say that the trial court's refusal to grant a new trial and its decision to let the $35,000 award stand constituted a reversible abuse of discretion. The type of injuries suffered by the plaintiff—physical pain, annoyance, stress, deprivation of the use and comforts of one's home—are intrinsically "not susceptible of exact pecuniary calculation."Krulikowski v. Polycast Corp., 153 Conn. 661, 220 A.2d 444 (1966). The determination of such damages is left to the sound judgment and discretion of the trier of fact. See Krulikowski; Wheat v. Freeman Coal Mining Corp., 23 Ill.App.3d 14, 319 N.E.2d 290 (1974); Alonso v. Hills, 95 Cal.App.2d 778, 214 P.2d 50 (1950) (amount of recovery in these matters discretionary, no necessity of specific evidence as to such amount).* [emphasis added]

## Case Study 15 (Quarry Blasting – Homeowner's Property Damaged and Sustained Loss in Value)

In *Ward v. HB Zachry Const. Co.* (Zachry),[220] the issue in dispute was a claim for damages to the homeowner's house caused by blasting at the defendant's quarry, distant 4,250 feet (1,295 metres) from the homeowner's house.

At trial, the jury awarded the homeowner $8,000, attributed to the diminution in the value of the homeowner's property as a direct consequence of the *blasting* at the quarry. The judgment of the lower court was upheld on appeal.

The quarry owner attempted to discredit the testimony of the homeowner, shift responsibility for the homeowner's property damage to another company operating in the area, and argue the implausibility of causing damage to a residence at a distance of 4,250 feet:

> *Defendant…argues that the trial court erred in failing to direct a verdict for defendant upon the grounds that plaintiff failed to establish a causal connection between defendant's blasting and plaintiff's alleged damages. Defendant advances three principal arguments in favor of this contention: (1) plaintiff's house had cracks in it before defendant began blasting; (2) another company was blasting in the same area at the same time; and (3) defendant's expert testified that the blasting which was done could not have damaged a house so far away.*

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[220] *Ward v. HB Zachry Const. Co.*, 570 F.2d 892 (1978), Court of Appeals, 10th Circuit, https://scholar.google.ca/scholar_case?case=17504658548879244532&q=damaged+quarry&hl=en&as_sdt=2006#[2]

In response to the quarry owner's first two arguments, the appeals court commented as follows:

> *We have little difficulty in concluding that there was sufficient evidence in plaintiff's favor that we may reject defendant's first two arguments. Although plaintiff admitted that her house had some cracks before the blasting started, the evidence when viewed most favorably to plaintiff establishes that the condition of the house was worsened by defendant's blasting. Similarly, although the presence of another company in the area did cause some confusion, there is sufficient evidence in the record to indicate that plaintiff was able to accurately trace the damaging blasts to defendant.*

The quarry owner's third argument that the homeowner's *lay* testimony could not overcome the testimony of an expert witness and that blasting at the quarry could not cause property damage at a distance of 4,250 feet was also rejected by the appeals court, commenting as follows:

> *Defendant's third argument is that its expert witness testified that the blasting which was done could not have damaged a structure as far away as plaintiff's house and that plaintiff's lay testimony cannot overcome the testimony of an expert. We reject defendant's contention that this is a question which can be resolved only by expert testimony.* ***Despite the testimony of defendant's expert that the damage could not have occurred because of the blasting, the record contains plaintiff's testimony that it did****. We must view favorably plaintiff's testimony that she simultaneously heard the explosions, felt the vibrations, and saw and heard mortar falling from the walls and ceiling of her house. [emphasis added]*
>
> ***Plaintiff [Ward] testified that as defendant blasted, she heard the explosions and felt the resulting concussion and vibrations. Plaintiff testified that as defendant blasted she often directly viewed mortar falling out of cracks in the wall or ceiling, or heard the mortar fall in another room and would later discover bits of mortar on the floor.*** [emphasis added]

On the issue of acceptance of lay testimony, the appeals court cited the following case law:

> *Testimony similar to that of plaintiff [Ward] in this case has been accepted in other cases as adequate evidence of causality. In Smith v. Clark, 315 P.2d 960 at 962 (Okl.1957) the testimony was that Mrs. Clark was at home at the time of the blast, that she felt the vibration and heard the crystal in the cabinets tinkle, and that she found cracks which had not been there before the blasting. In Smith v. Yoho, supra, 324 P.2d at 532, the plaintiff testified that she was in the damaged building at the time of the blast, that the building shook and the lights tingled, and that she observed mortar falling from cracks in the building. In the latter case, the Oklahoma Supreme Court rejected contentions similar to those proffered by defendant [Zachry] in this case:*
>
> > Defendant's contentions that no causal connection was established between the act of blasting and the damage to the property and that the verdict was clearly against the weight of the evidence, are both apparently based upon defendant's theory that plaintiff could only establish causal connection and the right to recover by the use of expert testimony. Defendant asserts that plaintiff had no expert testimony and that defendant did have such testimony, and therefore concludes that defendant is entitled to prevail as a matter of law. We do not agree. The evidence in the case at bar is substantially similar to the evidence approved as sufficient by this court in the case of *Smith v. Clark*, Okl., 315 P.2d 960. We are of the opinion and hold that the evidence in case at bar likewise reasonably supports the judgment and is sufficient to establish causal connection.
>
> *See also Superior Oil Co. v. King, supra,* 324 P.2d at 848; *Pate v. Western Geophysical Co. of America,* 91 So.2d 431 (La.App.1956) (evidence sustained finding of causality despite expert testimony as to scientific impossibility); and *Central Exploration Co. Inc. v. Gray,* 219 Miss. 757, 70 So.2d 33 (1954).

As to estimating the diminution in the value of the homeowner's property, it was acknowledged that the house had some cracks before the blasting from the quarry, but

"some uncertainty as to which cracks were caused by the blasting and which were caused by settlement and age need not prevent recovery." *Oklahoma Transportation Company v. Hays,* 405 P.2d 181,

> *The record discloses that plaintiff's [Ward's] expert was qualified and that his opinion was based upon plaintiff's descriptions which the jury found reliable. The amount of the jury's verdict reflects that some credence was given either to defendant's [Zachry's] expert or to the points brought out on cross-examination by defense counsel. While the jury was engaged in resolving conflicting testimony as to the amount of damages, we do not believe that the jury was involved in mere speculation. The evidence shows the extent of damages as a matter of just and reasonable inference.*
>
> *Plaintiff's expert testified that the house was worth $15,000 before the blasting and nothing thereafter. Defendant's expert, apparently utilizing the same methods as plaintiff's expert, testified that the house was worth $11,500 at the time the blasting started and $6,000 thereafter. Thus, plaintiff's expert put the loss at $15,000, while defendant's placed the loss at $5,500. The jury verdict was for $8,000.*

Both appraisers applied the *before- and after-method* of valuation in deriving the diminution in value (i.e., loss in Market Value) attributed to the damage caused to the homeowner's property by the blasting at the quarry.

In Oklahoma, the use of explosives imposes strict or absolute liability without regard to proof of negligence, as conceded by the quarry owner. *States Exploration Company v. Reynolds,* 344 P.2d 275, 278 (Okl.1959); *Superior Oil Company v. King,* 324 P.2d 847, 848 (Okl.1958); *Smith v. Yoho,* 324 P.2d 531, 533 (Okl.1958); *Seismograph Service Corporation v. Buchanan,* 316 P.2d 185, 186-187 (Okl.1957); *Tibbets & Pleasant v. Benedict,* 128 Okl. 106, 261 P. 551, 552 (1927); *City of Muskogee v. Hancock,* 58 Okl. 1, 158 P. 622 (1916); *Garland Coal & Mining Company v. Few,* 267 F.2d 785, 788 (10th Cir. 1959).

> *…[However,] defendant [Zachry] argues that no Oklahoma case has applied strict liability in a factual situation in which the distance between the blasting site and the damaged property was over 600 feet.*[221] *The other side of this coin, however, is that no Oklahoma case has held that strict liability was inapplicable to blasting more than 600 feet away from the damaged property.*[222]

### Case Study 16 (Homeowners Awarded Damages in Nuisance Claim Over Quarry Truck Traffic)

In 1991, the City of Greenwood (City) and Martin Marietta Materials, Inc. (MMM) entered into a contract that allowed trucking companies to use Second Avenue when traveling to and from the quarry. Use of Second Avenue occurred without incident until 2006, when, in an effort to control traffic, the city passed an ordinance (by-law) imposing weight restrictions on trucks travelling along Second Avenue. Subsequently, the City passed a second ordinance prohibiting commercial vehicles from using the city's streets unless the street was designated "Commercial Route." In effect, the ordinance prevented trucks from

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[221] Defendant's [Zachry's] assertion in this regard does not appear to be strictly correct, for in *Seismograph Service Corp. v. Buchanan, supra,* 316 P.2d at 186, the opinion noted that the blasting was done 600 feet from plaintiffs' house and noted that damage was also sustained by certain other structures which "were an even greater distance from the point of explosion than was their house."

[222] It seems apparent that a rule attempting to predicate the application of strict liability upon some arbitrary distance requirement such as 600 feet would be worthless if it did not take into account many other factors including especially the intensity of the charge which was detonated. [emphasis added]

using Second Avenue. Subsequently, both ordinances were ruled invalid by the courts. The City of Greenwood then designated Second Avenue as the route to be used for quarry traffic. Greenwood is a town of about 4,500 residents in southeast Jackson County, MO. In December 2017, after a six-year legal battle, MMM was ordered to pay 18 current and former Greenwood residents a total of $831,000, with separate verdicts ranging from $6,590 to $156,974, as damages for a claim of nuisance.

> *Testimony at the three-week trial revealed that as many as 750 trucks a day rumble past their homes, shaking houses, breaking windows, spitting gravel and dust, sometimes exceeding the speed limit and preventing parents form letting their children play outside in their front yards.*

### Case Study 17 (Refusal to License a Quarry – Incompatible Land Uses, Cumulative Negative Externalities, and Health and Safety Issues)

In *Martin Marietta Mater v. Bd of Zoning Adj.*,[223] the Circuit Court reversed the Board of Zoning Adjustment (BZA) decision denying MMM's application for a special use permit to operate a quarry, "concluding that the decision was not supported by substantial and competent evidence on the record as a whole."

The BZA, the City, and additional intervenors appealed the circuit court's judgment.

> *MMM contend[ed] that the BZA erred in denying the application for a special use permit because the BZA improperly relied upon findings about "general compatibility" and "general welfare" in reaching that decision. MMM claims that denying the application on this basis was an abuse of discretion, was unlawful, and was arbitrary and capricious [para. 12].*
>
> *MMM contend[ed] that the BZA had no authority to deny a special use permit based upon concerns about "general compatibility" or "general welfare,"…claim[ing] these are legislative concerns that have no place in an administrative decision to grant or deny a special use permit [para. 13].*
>
> *MMM claims that the BZA's conclusions that adequate provisions had not been made with regard to "general compatibility" or "general welfare" were not supported by substantial and competent evidence. MMM argues that the BZA rejected the testimony of the neighbors related to general compatibility and that no evidence remained to support the conclusion that adequate provision had not been made related to general compatibility and general welfare.*

The majority ruling of the appeals court rejected all of MMM's arguments. The Zoning Ordinance in dispute requires that:

> *[b]efore any permit shall be granted the Planning Commission shall make written findings certifying that adequate provision has been made for the following:*
>
> *1. The location and size of the proposed use in relation to the site and to adjacent sites and uses of property; and the nature and intensity of operations proposed thereon.*
>
> *2. Accessibility of the property to police, fire, refuse collection and other municipal services; adequacy of ingress and egress to and within the site; traffic flow and control; and the adequacy of off-street parking and loading areas.*
>
> *3. Utilities and services, including water, sewer, drainage, gas, and electricity, with particular reference to location, availability, capacity and compatibility.*
>
> *4. The location, nature, and height of buildings, walls, fences, and other improvements; their relation to adjacent property and uses; and the need for buffering and screening.*

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[223] *Martin Marietta Mater v. Bd of Zoning Adj.*, 246 S.w.3d 9 (2007) https://scholar.google.ca/scholar_case?case=2443837302635348511&q=Quarry+blasting&hl=en&scisbd=2&as_sdt=2006.

*5. The adequacy of required yard and open space requirements and sign provisions.*

*6. The general compatibility with adjacent properties, other properties in the district, and the general safety, health, comfort and general welfare of the community.*

After making these findings, the Ordinance requires the Planning Board to make a recommendation to the BZA, which then decides whether to grant or deny the application. In regard to granting or denying the application, Article III of the Zoning Ordinance states:

*The [BZA] is hereby authorized to decide whether special use permits shall be granted subject to the general and specific standards in the Ordinance; to grant special use permits with such conditions or restrictions as are appropriate to protect the public interest and to secure compliance with this Ordinance; and to deny requests which fail to satisfy the standards and requirements contained herein and which are not in harmony with the purposes and interest of this Ordinance and the health, safety, and welfare of the community. The [BZA] shall decide whether special use permits shall be granted only after having received a recommendation from the Planning Commission. In no event shall a special use permit be granted where the proposed use is not authorized by the terms of this Ordinance, or where the standards of this Article are not met.*

The Zoning Ordinance further provides:

***In no case shall a special use permit be granted if the proposed use will constitute a nuisance or a public health or safety hazard to adjacent properties or to the community at large***.[224] [emphasis added]

In its "Findings of Fact and Conclusions at Law," the BZA found,

*that the land surrounding the property is primarily used for agricultural and single-family residential use and that the surrounding property "has developed primarily for residential use and is prime residential development." The BZA further noted that the subject property and the surrounding property abut the corporate limits of the City and that all this land was the subject of annexation proceedings initiated by the City. The BZA concluded:*

*1. It appears that most of the requirements for the special use permit have been met with the exception of Article VIII Section C Item 6 which reads as follows: The general compatibility with adjacent properties other properties in the district and the general safety, health, comfort and general welfare of the community.*

*2. The quarry should not expand toward surrounding residential development since this would accentuate the incompatibility of the two land uses.*

*3. In considering the best interests of the entire community and not just the interest of particular property owners or neighboring property owners, the Board of Zoning Adjustment concludes that the permit application should be denied.*

*4. The Board of Zoning Adjustment concludes that the Applicant has not made a sufficient showing to warrant the granting of the application, and the application for special use permit is, therefore, denied.*

In upholding the BZA's decision to deny the special use permit, the majority opinion of the appeals court stated,

*Such considerations have been held to properly support the denial of a special use permit. See Moto, Inc. v. Board of Adjustment of City of St. Louis, 88 S.W.3d 96, 102-03 (Mo.App. E.D.2002)*

[224] In making its findings and recommendations in the case at bar, the Planning Board expressly declined to consider evidence related to whether the proposed activity constituted a nuisance to surrounding landowners, recommended by the staff, and deferred consideration of that issue to the BZA.

*(holding that the Board of Adjustment did not err in denying a conditional use permit because competent and substantial evidence supported a finding that the proposed use would not complement or be compatible with surrounding uses) [para. 14].*

The appeals court also alluded to the Cass County Comprehensive Plan, which states that the use of land has an impact beyond the boundary of the land being used, and the best way to avoid an externality is to separate incompatible land uses:

***One of the most basic factors affecting the use of a given parcel of land is the use of adjoining parcels. This is due to the fact that the use of land has an impact that goes beyond the boundary of the land being used. Economists refer to this impact as a `land use externality' because it is generally not included in the property owner's decision-making process since it is external to the efficiency and profitability of the property being used. As an example of land use externalities, a house surrounded by sand and gravel pits is less enjoyable to live in and has less value for residential purposes than the same house surrounded by similar houses. The noise, smoke and heavy truck traffic generated by the excavations are so incompatible with residential life that the value of the house declines. Yet the gravel pit owners have no economic incentive to lessen the impacts of their activities since the declining value of the house does not affect the profitability of their businesses. In effect, it is a cost imposed by the gravel pit owners on the owner of the house....The best way to minimize these external costs is to separate incompatible land uses or buffer them from each other [para. 15]***.[emphasis added]

The appeals court concluded that,

*While the BZA entered findings of fact identifying the conditions under which MMM agreed to operate the quarry (i.e., setbacks, berms, fences, no increase in production at existing facility), it made no factual findings related to what extent those conditions served to minimize the negative externalities generated by the quarry and the overall incompatibility of the two property uses.* ***While the BZA concluded that adequate provision had been made related to the first five factors, the BZA's conclusion that adequate provision had not been made to account for the overall inconsistency of the proposed quarry with the surrounding residential property resulted from the cumulative effect of all the externalities generated by the quarry****. For this reason, the conclusions of the BZA need not be viewed as inconsistent and, under our standard of review, must be affirmed [para. 17].*[225] [226] *[emphasis added]*

## Case Study 18 (Refusal to License a Lawful Quarry – Blasting Common Law Nuisance)

At an environmental board hearing that lasted 10 days, followed by oral argument, and that generated 2,202 pages of testimony, the decision of the Environmental Hearing Board (EHB) to deny *Glasgow Quarry*[227] a permit to continue quarry operations on the grounds of inadequate public safeguards was upheld. On appeal *Glasgow Quarry* argued the sufficiency of *oral* and *visual* testimony, and as to whether the EHB applied the proper standards in its determination that the blasting operation constituted a common law industrial nuisance:

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[225] Even if the conclusions reached by the BZA with regard to the first five factors were inconsistent with its conclusion on the sixth, that inconsistency in conclusions would, at most, merit remand to the BZA for further findings and conclusions and would not dictate issuance of the special use permit.

[226] Application for Transfer to Supreme Court Denied January 29, 2008. Application for Transfer Denied March 18, 2008.

[227] *D.E.R. v. Glasgow Quarry*, 23 Pa. Commw. 270 (Pa. Commw. Ct. 1976) 351 A.2d 689, https://scholar.google.ca/scholar_case?case=15884448365410180316&q=DER+V+Glasgow+Quarry&hl=en&as_sdt=2006.

> *[T]he permit requested in the May 3, 1973 application was denied on the grounds that the blasting procedures used and to be used did not adequately safeguard the public.*

Reports prepared by blasting experts of national reputation, together with seismographic reports, showed that vibrations "peak particle velocity," were substantially below the 2.0 level determined to be the "maximum allowable as recommended by the U.S. Bureau of Mines." Nevertheless, the testimony of the *Department of Environmental Resources'* (DER) expert, which included *oral* and *visual* testimony, proved more persuasive:

> *The appellee [DER] offered one expert who made at least two trips to the site and examined the alleged blasting damages to property in the vicinity. His "visual" examination led him to conclude, taking all factors into consideration, that the blasting was causing the alleged damage.*

EHB's finding that blasting constitutes a *public nuisance* was upheld on appeal, with the court commenting as follows:

> *A study of the blasting cases in which the blasting was declared to be a nuisance indicates that where there is credible evidence that the blasting is causing damage to the property of others, as there is here, and if it is so found as a fact, as it has been here, a public nuisance does exist. See Beecher v. Dull, 294 Pa. 17, *274 143 A. 498 (1928); House of Refuge v. J. T. Dyer Co., 43 Pa. Super. 320 (1910). See also Federoff v. Harrison Construction Co., 362 Pa. 181, 66 A.2d 817 (1949).*

### Case Study 19 (Validity of Zoning Ordinance and Cumulative Effect of Adverse Impacts)

In *Lambrecht v. County of Will*,[228] the appeals court upheld the County's denial of a special use permit to allow *Lambrecht* to operate a quarry. The subject property consists of 185.44 acres of farmland zoned *A-1 Agricultural*, and is bounded on the south, east and west by other farms. Immediately north of the property is a single-family residential subdivision containing some older homes and some vacant lots. On appeal, the court rejected the plaintiff's argument that

> *the ordinance was arbitrary, unreasonable and without a substantial relationship to the public health, safety, morals, or general welfare.*

The sole issue on appeal was whether the judgment of the trial court was contrary to the manifest weight of the evidence.

> *"[A] zoning ordinance will be upheld if it bears any substantial relationship to the public health, safety, comfort or welfare. An ordinance will be presumed to be valid, and the one attacking an ordinance bears the burden of demonstrating its invalidity. The challenging party must establish by clear and convincing evidence that the ordinance, as applied, is arbitrary and unreasonable and bears no substantial relation to the public health, safety or welfare." Tomasek v. City of Des Plaines (1976), 64 Ill.2d 172, 179-80, 354 N.E.2d 899, 903 [para. 594].*

As to whether a quarry operation is an appropriate use of the land in the context of the surrounding land uses and the character of the community, the court conducted an assessment of relevant criteria to make that determination:

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[228] *Lambrecht v. County of Will*, 217 Ill. App. 3d 591 (Ill. App. Ct. 1991) 577 N.C.2d 789, https://scholar.google.com/scholar_case?case=13855044279831539095&q=lambrecht+v+county+of+will&hl=en&as_sdt=2006.

> *The parties agree that the relevant factors in determining the validity of a zoning ordinance are: (1) the existing uses and zoning of nearby property; (2) the extent to which property values are diminished by the particular zoning restrictions; (3) the extent to which the destruction of the property values of plaintiff promotes the health, safety, morals, or general welfare of the public; (4) the relative gain to the public as compared to the hardship imposed upon the property owner; (5) the suitability of the subject property for the zoned purposes; and (6) the length of time the property has been vacant as zoned considered in the context of land development in the area. (La Salle National Bank v. County of Cook (1957), 12 Ill.2d 40, 145 N.E.2d 65.) Additional considerations include the degree of care which the community has taken to plan its land use development and any evidence of community need for the proposed use. (Sinclair Pipe Line Co. v. Village of Richton Park (1960), 19 Ill.2d 370, 167 N.E.2d 406.) No one factor is controlling. La Salle National Bank, 12 Ill.2d 40, 145 N.E.2d 65 [para. 594].*

The cumulative effect of a number of potential adverse impacts on the community were cited by the appeals court in upholding the lower court's ruling in favour of the County to deny a permit to operate a quarry:

> *Given the evidence of the incompatibility of a quarry operation with surrounding land uses, the potential effect on the groundwater supply, the effects of blasting on nearby property, and the impact on the value of neighboring property, we agree with the trial court that plaintiffs have not proved by clear and convincing evidence that denial of the special use permit was arbitrary, unreasonable, and without a substantial relationship to the public health, safety, or general welfare. Cf. Meyer Material Co. v. County of Will (1977), 51 Ill. App.3d 821, 366 N.E.2d 1149 [para. 602].*

### Case Study 20 (Ordinance Passed to Stop Adverse Impacts, Including Flyrock, from Quarrying & Blasting Within City Limits)

In *Vulcan Materials Company* (Vulcan) *v. City of Tehuacana*, the City passed an Ordinance on December 8, 1998, which precludes *quarrying*, *mining* and *blasting* activities within the City limits. The City of Tehuacana has approximately 300 to 350 residents. Vulcan proposed to expand its quarry operation on land it held under a Lease pursuant to an asset purchase of Smith Crushed Stone (SCS), the former quarry operator, in October 1997, on 47 acres within the City limits, and challenged the validity of the Ordinance, claiming it is, in effect, an unconstitutional taking of its Leasehold interest without compensation.

> ***Before it passed the contested ordinance, the City held public hearings. Numerous citizens complained about Vulcan's operations outside the City as well as the two blasts conducted inside the City limits. Specifically, the citizens complained that Vulcan's activities caused shaking of houses, lifting furniture off the floor, rattling windows, shaking and jostling people in their homes, noise, dust, smoke, property damage, fear, interference with enjoyment of property and life, interference with the use of public roads and streets, and exposure to fly and throw rock. The City, and the district court, cite one flyrock incident in particular that had occurred when SCS was conducting quarrying activities on the tracts outside of the City in which a 500-pound boulder was propelled into a Tehuacana resident's yard. Residents also complained that the mining activities caused springs and wells in the area to dry up.*** [emphasis added]

On September 25, 2002, the District Court granted the City's Motion for Summary Judgment, holding that the 1998 Ordinance was not an unconstitutional taking or inverse condemnation (de facto taking) under Texas law. The District court held that the Ordinance advances a legitimate state interest, which seeks to regulate a nuisance (i.e., blasting, quarrying and mining).

Vulcan's appeal followed, and the appeals court overturned the Summary Judgment, and ordered a trial to determine whether there was a de facto taking of Vulcan's leasehold interest in the land within the City limits of Tehuacana, for which compensation is due, while acknowledging the persuasive argument put forth by the City as to the quarry being a nuisance:

> ***Initially, we acknowledge that there is persuasive evidence put forth by the City describing the negative impact quarrying has had on the City of Tehuacana — i.e., concussion, noise, dust, vibration, shaking of houses and furniture, fly rock, depletion of groundwater, etc. We also recognize that these activities are occurring adjacent to public streets and near several homes***.

A search of the City of Tehuacana website indicates that Ordinance No. 12898, "*An Ordinance Forbidding Quarrying or Blasting Operations Within The City Limits*" remains in effect.[229]

[229] Ordinance No. 12898, https://static.secure.website/wscfus/10353646/25987757/4-blasting.pdf.