

Red-Light Cameras Profit from Engineering Malpractice (Unabridged)

Brian Ceccarelli, PE; David J Raimondo, Esq.

Draft 33: 2023-09-20

One night in Cary, North Carolina, I, Brian Ceccarelli, was driving at the speed limit toward an intersection with a red-light camera, and the light turned yellow. I was too close to stop, but too far to proceed. I knew that if I chose to stop, I would not have enough distance to stop before the line. But, if I chose to go, I might not make it in time and run the red light. I did the logical thing. I stepped on the gas.

I did not beat the light. I saw the red-light camera flash in my rear-view mirror. I must have run a red light. By looking at the road ahead of me, I could not tell whether I had run a red light. If I ran the light, it was unavoidable. There was nothing I could have done. My thought as I drove away from intersection: "Certainly this yellow light does not abide by Newton's second law of motion." Newton's second law of motion relates time, distance, velocity and acceleration. Travelling at the speed limit for the amount of yellow time that I had been given was not enough time to traverse the distance to the intersection.

How does one confront government engineers in order to prove that the yellow light duration does not conform to Newton's second law? The lawful obligation of the engineers, working on behalf of government, is to conform their practices to the laws of physics. Conformance is stated in the engineering practice statutes, articles, codes or regulations. If that short yellow light time is outside of those scientific parameters, it was in violation of state law and was negligence per se. "As a rule, violation of a state statute that imposes a specific duty constitutes Negligence Per Se, or may even create Absolute Liability."¹

Fountain of Revenue

Billions of dollars in penal fines are the outcome of enforcing red-light violations where the underlying yellow light is too short according to the laws of physics. Imagine enforcing a law requiring drivers to travel 60 miles in 1 hour but setting the speed limit at 55 mph. Given hundreds of millions of drivers, the city will make a fortune by issuing speeding tickets or fining drivers for not reaching the destination in an hour. Red-light camera enforcement is like that. When a traffic light turns yellow and a driver is too close to comfortably stop, the yellow light needs to last long enough for the driver to travel the remaining distance into the intersection. But the yellow light is not long enough. Given the distance and the driver's speed, physics requires more yellow light time to reach the intersection. In

common scenarios, the driver must run a red light or attempt to beat the light. Here, the red-light camera company and municipality make a fortune.

With 15 red-light cameras, the Town of Cary, North Carolina issued more tickets than its entire population in 8 years. That is 136,957 tickets.² At \$50 per ticket, that is about \$7 million.

Larger cities make far more money. The City of Chicago has made over \$1 billion.³ Suffolk County, New York—at the east end of Long Island--makes \$31 million per year.⁴ Nassau County, New York—at the west end of Long Island, makes \$48 million per year.⁵ The State of California makes \$160 million per year⁶ and that does not include the extra \$970 million that California auto insurance companies make by increasing premiums over a period of 3 years.⁷ Many things boost the violation rate; for example, ticketing right-turn-on-red drivers, shortening the yellow further, and not-so-obvious things like decreasing the traffic signal cycle and setting a small red-light camera grace period. Differences in revenue also vary on how much a municipality charges per violation. In North Carolina, each violation is \$50 with no insurance points. In California, each violation is about \$490 and applied insurance points. Physics errors create all this revenue. Those errors are in the “ITE yellow change interval practice.”

ITE Yellow Change Interval Practice

Most jurisdictions in the world have adopted the “yellow change interval practice” written by the Institute of Transportation Engineers (ITE). The yellow change interval is the engineer's term for the duration of time the steady yellow light appears on a traffic signal. When I first saw ITE’s math equation in the NCDOT Traffic Signals Manual,⁸ it took me about 20 seconds to realize this equation makes everyone run red lights. As for beating the red light--also known as squeezing the lemon--it *is* the logical thing to do and ITE directs drivers to do exactly that.⁹ The bottom line is that the math, as applied and published by ITE and adopted by all states, is wrong and does not conform to Newton's second law of motion. The ITE math equation calculates yellow lights that are systematically too short. One does not have to make the yellows shorter to create a problem. They are short to begin with. These short yellows create what is known as “dilemma zones”. Dilemma zones are engineering defects which cause drivers to unintentionally run red lights. Dilemma zones are present at every signalized intersection.

A dilemma zone is a segment of roadway upstream from the intersection such that if the driver is in it when the light turns yellow, he neither has the distance to *comfortably* (which includes *safely*) stop, nor has he enough time to proceed into the intersection before the light turns red. The driver faces a no-win scenario. The driver must run the red light. The business model of red-light camera firms is founded upon capitalizing on dilemma zones. In a symbiotic relationship, the firms offer their

photo technology and revenue-gathering systems to governments in exchange for the governments' power to enforce traffic laws. The red-light camera firms harvest the fines and share the revenue with governments. Because the ITE practice contains simple misapplications of physics, anyone--including employees in red-light camera firms--can predict which intersections will generate the most money and then target communities with the most and longest dilemma zones. Such communities are Cary, North Carolina; Suffolk County, New York; and Chesapeake, Virginia.¹⁰

Traffic engineers deny that they are the ones responsible for creating dilemma zones.

However, in March 2020, my colleagues¹¹ and I persuaded the national office of ITE to acknowledge that its equation, adopted in the year 1965, was algebraically wrong as ITE applies it, and that ITE incorrectly sets the equation's input values for perception-reaction time and braking deceleration to the 50th percentile. The 50th percentile, de facto, makes *half* the driving population run red lights. Human factors engineering should cover all drivers, not just half the drivers.

ITE acknowledged some of its mistakes. ITE admitted that the 1965 algebra handles only the special case that when you see the green light turn yellow, you either choose to stop or to proceed at the speed limit or faster. This scenario is the most common. It applies to drivers going straight without slowing down for obstacles. But if you are too close to comfortably stop and you need to brake, even

just a little while on route into the intersection, the math of the yellow change interval does not accommodate the delay. The light can easily turn red before you cross the stop line.

Because turning drivers always slow down headed into the intersection or else risk overturning their vehicles, ITE replaced its old equation with a new one in March 2020. ITE applies the new equation to left turns only, but the physics applies to right turns as well. The new algebra adds 2 to 4 seconds to the yellow change interval. Without these additional seconds, the yellow light is so short that vehicles still turning left can be in the intersection while vehicles from the conflicting direction get a green light to proceed.

ITE's old algebra not accommodating left turning vehicles explains why there are 15 times^{12,13} more left-turn crashes than crashes involving two vehicles going straight. Exacerbating the faulty algebra, causing even more red-light runners, is that most traffic engineers arbitrarily cap the left-turn yellow at 3 seconds. These engineers assume all cars will approach at 20 mph despite a higher posted speed limit. They actually believe that the speed limit is lower in the left turn lane.¹⁴

The new 2020 ITE equation is still incorrect and remains incomplete. Just like the old equation, the 2020 equation applies only to a special case. Neither equation applies to impeded motion. An example of impeded motion is a driver about to enter an intersection but in the last few seconds has to

slow down for a vehicle in front of him. Both equations force the driver to run the red light. There is an equation that applies to the general case which expresses the simple relationship between time, velocity and acceleration ($t = v/a$) derived from Newton's second law, but no jurisdiction uses it.

Despite ITE's recent confession to its errors, these errors have been known for decades.^{15,16}

Perception of a Red Light Runner

The public's perception of a red-light runner differs greatly from that of the red-light camera industry and the traffic engineering community. Whereas the public sees red-light runners as reckless scofflaws, the red-light camera industry sees red-light runners as safe drivers passing over the stop line a fraction of a second after the light turns red. 70% of red-light incursions are sub-second.¹⁷ These violations occur so soon after the light turns red, that neither the driver nor a person watching a red-light camera video clip can discern whether the vehicle actually ran the red light.¹⁸

Further, traffic engineers divide red-light runners into two camps: violators and non-violators. The violators are the unsafe drivers. The non-violators are the safe drivers who are entrapped by dilemma zones or who must deal with other engineering failures like stuck red-lights in the middle of the night. Given the physics and confirmed by data, we know that over 90% of all red-light running is caused by engineers implementing the ITE practice.¹⁹

False Advertising

Governments and their red-light camera partners advertise that the cameras are for "safety."

But by watching the typical daily red-light camera clips²⁰, it is obvious that the cameras are not about safety. In Suffolk County, for every 100,000 red-light camera tickets issued, 99,888 are from safe red-light incursions into the intersection; that is, incursions where there were no crashes. For the remaining 112 incursions, we see 2 thru lane-only T-bone crashes, 25 left-turn T-bones crashes and 85 rear-end crashes. I derived these numbers from New York's Suffolk County's 2015 Red-Light Camera Safety Report²¹ and the crash type distribution from Route 25A at Miller Place. The ITE practice plus the presence of a red-light camera causes this distribution.²² Before-and-after camera studies consistently reveal that red-light cameras do not stop collisions, but rather turn T-bones into rear-end crashes.^{23,24,25}

In the presence of a red-light camera, drivers are more likely to slam on their brakes. Crashes occur because physics demands it.

Design Priority is Traffic Flow, then Safety, then Legal Motion

The red-light camera sector's obsession with crash data is a ruse. Red-light cameras are not about the *safe* motion of traffic; they are about the *legal* motion of traffic. Safe motion and legal motion are different, though they shouldn't be. An intersection can be made safe and not legal:

Imagine an intersection where drivers in all directions see red lights at the same time. An intersection can be made legal and not safe: Imagine an intersection where drivers in all directions see green lights at the same time. Intersections are between these two extremes.

Coming as a surprise to everyone, neither safety nor legality is the traffic engineer's top priority.

He sacrifices them both for the sake of maximizing traffic flow. Traffic flow is his top priority. The more cars flowing through an intersection in a day, the more successful the traffic engineer sees his intersection. The cheapest way to get more cars flowing is to shorten the time traffic is under yellow lights. (The expensive way is to add a lane.) However, less yellow light also means more red-light runners.²⁶

The engineer views his increase in red-light runners as acceptable²⁷ as long as he does not significantly increase crashes. A traffic engineer is willing to risk crashes if he can increase the flow of traffic.²⁸ As for the legal motion of traffic, the engineer deliberately creates legal problems for the driver--an act violating the engineer's rules of professional conduct. In a TxDOT report, the legal motion of traffic is his 7th priority.²⁹ To satisfy the flow goal, ITE instructs traffic engineers to tune intersections so that an "acceptable 1% to 3%" of drivers run red lights.³⁰

When confronted, the traffic engineer blames drivers for running red lights.^{31,32} The traffic engineer believes that a driver can always adapt to whatever yellow he sets, and that if he lengthens a yellow light, drivers would eventually "disrespect" the yellow and run more red lights.³³ The traffic engineer holds religiously to these tenets despite that physics and studies demonstrate the opposite.³⁴ Many traffic engineers even deny the universality of physics³⁵ though their profession is defined by it.

Constitutionality Issues

Photo-enforcement laws undermine the established legal landscape. It is tempting for the attorney to take on the Constitutionality issues, such as the lack of due process or presumption of guilt unless you fink on a family member or friend. These issues would appall our Founding Fathers and even would make King George III blush.³⁶ But these issues are insignificant compared to the problems hidden from public experience. The hidden problems are those of engineering malpractice.

Engineering malpractice is tangible and objective, and does rest not on opinions. Engineering malpractice in the context of red-light cameras is an unequivocal violation of the mathematical laws of nature, embodied in engineering practice statutes, codes, rules and regulations, to which engineers are bound by licensure and ethics. Red-light camera engineering is not just an affirmative act of negligence, but a reckless one, at the cost of human life from auto collisions. The veil of secrecy

surrounding the red-light camera industry, their municipal partners and engineers who massively profit under the guise of safety, is unconscionable. This complicit arrangement among actors to raise revenue is exposed by high school physics, and lawyers have the ability to right a wrong by litigating red-light camera engineering malpractice.

Litigate using the Engineering Practice Statute

The red-light camera industry is founded upon two pillars of engineering malpractice.

Government traffic engineers form one front. Red-light camera firms form the other. Under the guise of safety, red-light camera firms solicit governments and profit by the malpractice of government traffic engineers.

Traffic engineers, the first pillar, violate the engineering practice statute by adopting an ITE practice. 23 CFR 655, referring to the Manual of Uniform Traffic Control Devices (MUTCD), which is adopted as law in all states, requires traffic engineers to determine the yellow change interval according to engineering practices (MUTCD 4D.26-03). North Carolina's and New York's Suffolk County engineering statutes and guidelines explicitly define an engineering practice as the *application* of the mathematical and physical sciences.^{37,38} Other states have identical definitions. But an ITE practice is *misapplications* of the mathematical and physical sciences. Misapplications of math and physics are

engineering malpractice by definition. When a licensed professional engineer (PE) derives math or adopts bad math from any source--private, public or government, and writes it on his certified plans, he becomes responsible civilly and potentially criminally, for its errors and omissions.

Finger-Pointing Game

When it comes to holding someone accountable for short yellows in court, government plays a finger-pointing game. The plaintiff sues the host-municipality for bad yellows. The host-municipality blames the state DOT. The DOT claims sovereign immunity. When confronting the government's traffic engineer, the traffic engineer blames the state DOT, "I'm just following the DOT's standards" or points the finger at ITE or to the USDOT/Federal Highway Administration (FHWA), who points the finger back at ITE. The traffic engineer, by violating the state's rules of professional conduct, committing a misapplication of physics and defying engineering principles as stated by engineering practice statutes, articles, code or regulations, carries out the red-light camera scheme by which all who profit are complicit. Those who profit include the host-municipalities who adopt the red-light cameras, and the red-light camera firms who solicit and orchestrate the red-light camera programs.

Governments share legal responsibility with the red-light camera industry and engineering firms with whom they partner. A government its partners must uphold engineering practice law.³⁹ This

responsibility not only includes the traffic engineer's yellow change interval calculations, but also includes the engineering and plans for the installation of the red-light cameras on roadways.

Standard of Care

Even when boards of engineers and other government entities cannot refute the fact that the math is bad, they proffer the "standard of care" argument in order to shirk their responsibility of disciplining their engineers. They simply say, "Traffic engineers are using the ITE formula and are just acting out their standard of care." Andrew Ritter, Executive Director of the North Carolina Board of Engineers and Land Surveyors (NCBELS) said, "If an engineer uses a state-approved formula, even if that formula is proven faulty, NCBELS can't do anything If Ceccarelli's claim--that math misapplied by engineers causes unduly short yellow lights, leading directly to traffic accidents, injuries and deaths, was proven unequivocally true, NCBELS would not act."⁴⁰ This kind of standard of care argument is common among professional practices but the argument fails here. The yellow standard of care does not rise to the minimum definition of a standard of care required under state law, and the yellow change interval standard of care is not a mature technology. The statutory definition of an "engineering practice" is a practice that *correctly* applies math and physics. One cannot use $2 + 2 = 5$ as a standard of care. Also, a standard of care is established around a *mature* technology. A mature technology is one where the

failures have been identified and solved. The yellow change interval practice is not mature. For over 100 years, traffic engineers continue to fiercely debate how long yellow change intervals should be. Only on March 3, 2020, did ITE publish its *first* “recommended” practice. Up until then, not even ITE recommended its own practice. Now ITE has a recommended practice but no DOT wants to adopt it.

Red-light Camera Firms

Red-light camera firms foster and are complicit in engineering malpractice. Red-light camera installation plans contain complex engineering structures which affect public safety, and thus the plans must be signed and sealed by a professional engineer,^{41,42} licensed in the state where the red-light cameras are to be installed. The professional engineer must have had direct supervisory control over the project, and must have certified--signed, dated and sealed--the plans.⁴³ Most states also require the firm to have a license or certificate of authority to practice engineering in the state. Building permits to install camera systems can only be issued on the precondition that plans have been certified. To circumvent the law, red-light camera firms create the red-light camera plans and pass them onto engineering or construction companies doing business with the host-municipality. These firms conveniently do not certify the plans.⁴⁴ Without certification, the inescapable conclusion is that engineering firms in the host-municipality do not create the complex red-light camera plans. The red-

light camera firms do and pass them onto their partners. This is why red-light camera plans are often not certified. In Suffolk County, New York, they are not certified. "It's nothing but a camera on a stick!" said one Suffolk County legislator during a debate on this issue.

Red-light camera firms and governments are aware that people now want to see certified red-light camera installation plans. In the past, city clerks would honor a FOIA request and disclose the plans. Now red-light camera firms and governments are reluctant to disclose their red-light camera installation plans, or disclose the plans but redact the engineer's name.⁴⁵ Nondisclosure prevents a litigant from discovering that the plans are not properly certified, or if certified, from gaining the identity of the engineer and/or engineering firm that prepared the plans. At times, government claims that the plans are the private property of an out-of-state company,⁴⁶ or that disclosure would "jeopardize law enforcement".⁴⁷ These excuses conflict with the accountability mandate of licensed professionals, the whole reason why engineering practice law exists.

There is a more significant act of engineering malpractice by red-light camera firms than bad certification. While red-light camera advocates like to think of certification as a technicality, the substantive issue is the malpractice of systems engineering. In systems engineering, one must fix the base system before adding a dependent system. In our case, one must fix the traffic signal's short

yellows before adding the red-light camera system. Redirecting the blame for engineering failures to the public conflicts with every state engineering statute. Instead of safeguarding life, health, property and promoting public welfare, red-light camera systems do the opposite.

Future Litigation

It is my hope that attorneys will litigate the ongoing short yellow lights based upon the irrefutable evidence of causation. The proper foundation is the math,⁴⁸ which I encourage attorneys and engineers to learn, which has been ignored to the tune of billions of dollars at the expense of citizens in states with red light camera programs. The affirmative acts of negligence by engineers working on behalf of red-light camera firms and governments who partner with them must be held accountable. A class action lawsuit based upon an unequivocal violation of an engineering practice statute, articles, codes or regulations in creating short yellow lights for profit must be established as Negligence Per Se and/or Absolute Liability.

Notes:

You may download the reference material from <https://ceccarelli-pe.com/trial-unabridged>

1. Elliott v. City of New York, 95 NY2d 730, p. 2 (2001).
2. Brian Ceccarelli, *Cary Citations per Intersection*, p. 1 (2013).
3. Austin Berg, *Illinois Red-Light Cameras Have Collected More than \$1B from Drivers Since 2008*, Illinois Policy (2019).
4. Suffolk County Red Light Safety Program, SCTPVA, *2015 Annual Report*, p. 26 (Dec 2016).

5. Candice Ferette, Robert Brodsky, *Nassau County, N.Y., Sees Spike in Red-Light Camera Revenues*, Government Technology (June 11, 2018).
6. Various California City Police Departments, *Red-Light Camera Report for the Judicial Counsel* (2020) Number of citations sums to 324,760. At \$490 each, dollar amount sums to \$159,132,400.00.
7. The Zebra, *The State of Auto Insurance*, p. 22 (2019). Over a period of 3 years, 1 red-light running ticket will raise an individual's premium by \$999. 324,760 tickets/year x 3 years x 999 = \$970M. One may note that the Insurance Institute of Highway Safety (IIHS), a consortium of auto insurance companies, is a supporter of red-light cameras.
8. North Carolina Dept' of Transportation, *Transportation Systems Management and Operation Unit Design Manual--Signal Design Section*, Std. 5.2.2 Sheet 5 of 5 (July 2021).
9. Institute of Transportation Engineers (ITE), *Transportation and Traffic Engineering Handbook 2nd Edition*, p. 756 first paragraph of left column (1982).
10. Redflex Traffic Systems, *Automated Red Light Photo Enforcement RFP #9045 to Chesapeake, VA* (2014).
11. Mats Järnlström, Jay Beeber, See *ITE Journal* (March 2020).
12. New York Dept' of Transportation, *Collision Diagram Miller Place Rd at Route 25A, Suffolk County* (2015).
13. Brian Ceccarelli, *Histograms of Number of Vehicles Running Red Lights vs Time into Red Comparing Left Turns and Straight-Thru Movements at Walnut Street at Meeting Place, Cary North Carolina* (2017).
14. Joseph Hummer Deposition, p. 63 lines 7-12 (2012).
15. Institute of Traffic Engineers, *Traffic Engineering Handbook*, p. 407 (3rd ed, 1965).
16. ITE Technical Council Committee 4A-16, *Determining Vehicle Change Intervals*, ITE Journal, p. 29 middle column, paragraph starting with "The formula shown above" (July 1989).
17. Redflex Traffic Systems, *Cary, North Carolina All Photo-Enforcement Notices* (2012).
18. Brian Ceccarelli, *Red-Light Cameras--Whom They Really Ticket* (2017).
19. Redflex Traffic Systems, *Cary, North Carolina All Photo-Enforcement Notices* (2012).
20. Brian Ceccarelli, *Red-Light Cameras--Whom They Really Ticket* (2017).
21. Suffolk County Red Light Safety Program, SCTPVA, *2015 Annual Report* (Dec 2016)
22. New York Dept' of Transportation, *Collision Diagram Miller Place Rd at Route 25A, Suffolk County* (2015). See also citation 13: The number of red-light violations is at least 30 times greater in left turn lanes than in straight-thru lanes.
23. Alixandra Demers, *SafeLight Raleigh Camera Analysis Observational Before-After Study*, pp. iii, iv, v; AECOM (2013).
24. Justin Gallagher, Paul Fischer, *Cameras Can Catch Cars That Run Red Lights, But That Doesn't Make Streets Safer*, The Conversation (Aug 15, 2018).
25. Federal Highway Administration, USDOT, *Safety Evaluation of Red-Light Cameras, Publication NO. FHWA-HRT-05-048* (2005).
26. Brian Ceccarelli, et.al., *Number of Violations vs Yellow Change Interval for Several American Cities* (2015).
27. Gregory Fuller Deposition, considers crashes only, not whether drivers get tickets, pp. 51-52 (2012).
28. Alexander Mirsakov Deposition, traffic flow prioritized over fatalities, pp. 19-31 (2020).
29. Lei Yu, et.al., for the Texas Dept' of Transportation, *Yellow and Red Intervals to Improve Signal Timing Plans for Left-Turn Movement*, p. 28 (2003) "Traffic laws are 7th priority". The motive of Yu's paper is to denounce Chiu Liu's paper *Determination of Left-Turn Yellow Change and Red Clearance Intervals* (2002) which Yu co-authored. Liu/Yu's paper introduces a new yellow change interval formula for left turns--a formula which would increase the left turn yellow by several seconds so that drivers can legally enter the intersection. However, Yu, in order to push the agenda of

intersection efficiency, has traffic engineers vote on the design priorities. Traffic engineers vote that efficiency outweighs all other design priorities. By misapplying stochastic methods, Yu thus directs the TxDOT to make drivers run red lights for the sake of intersection efficiency.

30. ITE Technical Council Committee 4A-16, *Determining Vehicle Signal Change Intervals*, ITE Journal p. 30 first paragraph, (July 1989).
31. Joseph Hummer Deposition, p. 108 (2012).
32. Lisa Moon Deposition, p. 164, line 6 (2012).
33. Joseph Hummer Deposition, pp. 100-101 (2012).
34. Paul L. Olson, Richard W. Rothery, *Driver Response to the Amber Phase of Traffic Signals*, Operations Research 9(5):650-663, page 650 (1961).
35. Lisa Moon Deposition, pp. 23, 26, 27, "physics applies in a very limited vacuumed world", "Task Force did not use physics" (2012).
36. Adam McLeod, *The Time I Turned a Routine Traffic Ticket into the Constitutional Trial of the Century*, Public Discourse (January 13, 2017).
37. North Carolina General Statute § 89C-3(6).
38. New York Professional Engineering Practice Guideline 1.
39. North Carolina General Statute § 89C-23. "All political subdivisions of the state must uphold provisions of this Chapter"
40. Benjamin Schachtman, *Wilmington Red-Light Camera Lawsuit Joins Nationwide Effort Against 'Fifty-year old Error'*, Port City Daily, Wilmington NC (Jan 13, 2018).
41. North Carolina Board of Examiners for Engineers and Surveyors (NCBELS), *Case No. V2018-026 Against American Traffic Solutions* (2018).
42. New York State Board of Engineers and Land Surveyors, *Email Stating Red-Light Installation Plans are Engineering Practice* (March 16, 2016).
43. NCBELS, *Case No. V2018-002 Decision and Order Against Robert Rennebaum* (2019).
44. Nelson & Pope, Xerox Local and State Solutions, *Red-Light Camera Installation Plans with no Certification* (2016). Xerox knows that its plans must be certified because Xerox previously produced certified plans for the City of Raleigh, North Carolina. ACS, Xerox Local and State Solutions and Conduent are successor companies. See note #45 for certified Conduent plans for Raleigh.
45. City of Raleigh, North Carolina, *Red-Light Camera Installation Plans with Redacted Certification* (2018).
46. City of Fayetteville, North Carolina, *Email Stating American Traffic Solutions Won't Disclose Plans* (April 26, 2018).
47. New York City Dept' of Transportation, *Email Denying Disclosure Because Disclosure Would Interfere with Law Enforcement*, FOIL-2018-841-02430 (Feb 11, 2019).
48. Brian Ceccarelli, Joseph Shovlin, *Derivation of the Yellow Change Interval Equation* (2017).