REDACTION KEY

A. CLASSIFIED FBI INFORMATION RE-REVIEWED PURSUANT TO EXECUTIVE ORDER 14040.

C-1. INFORMATION OBTAINED FROM FOREIGN GOVERNMENT(S) AND WITHHELD AT THE DIRECTION OF ANOTHER U.S. GOVERNMENT AGENCY OR DEPARTMENT PENDING ONGOING CONSULTATION.

C-2 INFORMATION OBTAINED FROM FOREIGN GOVERNMENT(S) AND WITHHELD AT THAT GOVERNMENT''S DIRECTION FOLLOWING CONSULTATION IN ACCORDANCE WITH EXECUTIVE ORDER 14040.

D. INFORMATION FOR WHICH JUDICIAL AUTHORIZATION TO RELEASE IS REQUIRED. INFORMATION FOR WHICH JUDICIAL AUTHORIZATION IS OBTAINED WILL BE RELEASED.

F. ADMINISTRATIVELY DESIGNATED FBI FILE AND/OR SERIAL NUMBERS OR HANDLING INFORMATION.

G. SENSITIVE LAW ENFORCEMENT INFORMATION WITHHELD PURSUANT TO THE LAW ENFORCEMENT PRIVILEGE.

J-1. SECTION 102A(i)(1) OF THE NATIONAL SECURITY ACT OF 1947, AS AMENDED BY THE INTELLIGENCE REFORM AND TERRORISM PREVENTION ACT OF 2004, 50 U.S.C. § 3024(i)(1).

J-2. INFORMATION PROTECTED FROM DISCLOSURE BY THE BANK SECRECY ACT (BSA) AND THE U.S. DEPARTMENT OF THE TREASURY REGULATIONS IMPLEMENTING THE BSA. SEE 31 C.F.R. § 5311 ET SEQ; 31 C.F.R. CHAPTER X.

J-3 INFORMATION DETERMINED BY ANOTHER DEPARTMENT OR AGENCY TO BE PROTECTED FROM DISCLOSURE PURSUANT TO 8 U.S.C. § 1202(f).

O-1. INFORMATION WITHHELD AT THE DIRECTION OF ANOTHER U.S. GOVERNMENT AGENCY OR DEPARTMENT.

P. INFORMATION RESTRICTED FROM PUBLIC RELEASE UNDER THE PRIVACY ACT OF 1974. SUCH INFORMATION WILL BE PRODUCED IN MDL 03-1570 (S.D.N.Y.) PURSUANT TO THE PRIVACY ACT PROTECTIVE ORDER ENTERED IN THAT CASE.

P-1. INFORMATION SUCH AS SOCIAL SECURITY NUMBERS, DATES OF BIRTH, AND OTHER SENSITIVE PERSONAL INFORMATION.

S. NAMES AND OTHER PERSONAL IDENTIFYING INFORMATION OF LAW ENFORCEMENT PERSONNEL.

NOTE: Classification markings (classification banners and portion markings) are redacted without a code throughout the release.

[redacted]

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 04/05/2012

To: Counterterrorism **Attn:** [redacted] (G), (S)

San Diego **Attn:**

New York **Attn:**

From: San Diego
[redacted] (G)
Contact: SA [redacted] (S)

Approved By: [redacted] (S)

Drafted By: [redacted] (S)

Case ID #: [redacted] [redacted] (F)

Title: [redacted] MIHDAR MOHAMMAD AL MIHDAR ZAID
aka MOHDAR ABDULLAH
[redacted] (A), (G), (J-1)

[redacted] OPERATION ENCORE
[redacted] (A), (G), (J-1)

[redacted] OMAR AHMED AL-BAYOUMI
[redacted] (A), (G), (J-1)

[redacted] [redacted] (A), (G), (J-1)

[redacted] [redacted] (A), (G), (J-1)

Synopsis: [redacted] To document the analysis of a handwritten equation on a document seized at the residence of OMAR AHMED AL-BAYOUMI in the United Kingdom (UK). A copy of the document is attached and made

[redacted]

a part hereto.

[redacted] (G)

Reference: [redacted] [redacted] (F)

Attachment(s): [redacted] A copy of the document seized at the residence of OMAR AHMED AL-BAYOUMI in the United Kingdom (UK) has been attached and made a part hereto.

Details: [redacted] In late September 2001, a search was conducted by the Metropolitan Police Service (MPS) in the United Kingdom at the residence of OMAR AL-BAYOUMI (BAYOUMI). Pursuant to that search, a document (hereinafter referred to as the document) was seized which contained a handwritten equation along with other handwritten calculations and a sketch of what appears to be a plane. On 02/02/2012, Special Agent (SA) [redacted] (S) and SA [redacted] (S) [redacted] (S) were tasked with analyzing the equation in the document, which is shown below (Equation 1) as it was written in the document:

Equation (Eq) 1 $d = \sqrt{h(h + 8000}$

[redacted] SA [redacted] (S) has a Bachelor of Science Degree in Mechanical Engineering from the University of Utah and SA [redacted] (S) has a Bachelor of Science Degree in Aerospace Engineering from Virginia Tech and a Master of Engineering Degree in Mechanical Engineering from the University of Connecticut.

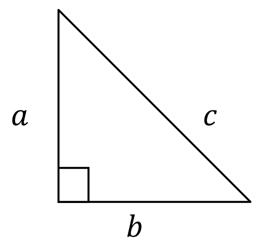
[redacted] Eq 1 above is written exactly as it was written on the document (without the closing parentheses). Directly below the equation, there appears to be a sketch of a plane with a vertical dashed line below it. Next to the dashed line directly below the sketch it was written that "h = hight[sic] the plane from the earth in mile". At the bottom of the dashed vertical line, a horizontal line was drawn forming two sides of a triangle. Next to the horizontal line was written d below which was written "distance from the plane to hurrizen[sic]". Furthermore, the equation was taken another step by squaring both sides and assigning two different values to d^2.

[redacted] The initial analysis of the equation by SA [redacted] (S) and SA [redacted] (S) was that it appeared to be a variation of the Pythagorean Theorem ($a^2 + b^2 = c^2$), an equation used to calculate the length of a side of a right-triangle when the lengths of two of the sides are known, see below:

Eq 2: $a^2 + b^2 = c^2$ Pythagorean Theorem

[redacted] The diagram below shows a right triangle with each side labeled a, b, and c from Eq 2:

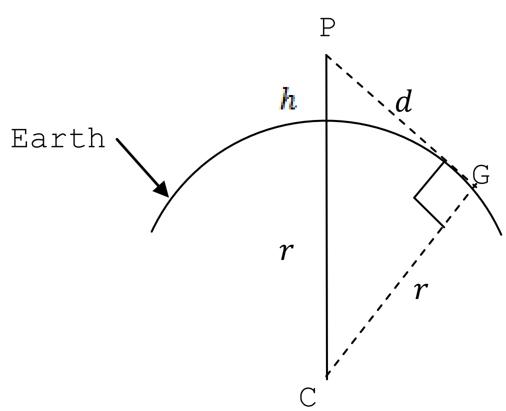
Diagram 1:



[redacted] Assuming that the equation is derived from the Pythagorean Theorem, and given that the units were in miles, as designated by the writer of the equation, SA [redacted] (S) and SA [redacted] (S) concluded that the numeric constant of 8000 in Eq 1 was most likely referring to the diameter of the earth (FBI note: the diameter of the earth is approximately 7,926 miles (About.com)).

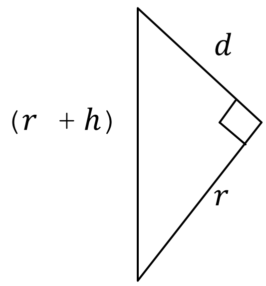
[redacted] Given this assumption, and the fact that the writer of the equation had provided the object as a "plane" a certain distance above the earth (h) and a certain distance from the horizon (d), SA [redacted] (S) performed open source checks on a 'distance to horizon' equation. A paper published in 2010 by [redacted] (P) with the San Diego State University Astronomy Department used the same type of equation, which was derived from the Pythagorean Theorem, to calculate the distance of an object above the earth's surface to the horizon. Below is a diagram showing how the calculation is set up:

Diagram 2:



[redacted] Points P, C and G (the vertices of the triangle) represent the "plane" (object above the earth's surface), the center of the earth, and a point on the horizon, respectively. Lines h, d, and r represent the height of the "plane" (P) from the earth, the distance from the plane (P) to a point on the horizon (G), and the radius of the earth (r), respectively. Line d is tangent to the surface of the earth, making lines d and r perpendicular at point G. Thus the triangle shown in Diagram 2 above is a right triangle labeled as follows:

Diagram 3:



[redacted] Below is the Pythagorean Theorem based on the coefficients from Diagram 3 (r, d, and $(r + h)$) which were substituted for a, b, and c in Eq 2, respectively:

Eq 3 $\quad r^2 + d^2 = (r + h)^2$

[redacted] Note that the value of the hypotenuse (the leg of the triangle opposite the right angle), which in this case is the radius of the earth plus the height of the "plane", is substituted for c in equation $a^2 + b^2 = c^2$. At this point, Eq 3 can be derived to the exact equation that was written in the document (see Eq 1):

Eq 3 => $r^2 + d^2 = (r + h)^2$

=> $r^2 + d^2 = (r + h)(r + h)$

=> $r^2 + d^2 = r^2 + 2hr + h^2$

=> $d^2 = r^2 + 2hr + h^2 - r^2$

=> $d^2 = 2hr_1 + h^2$

=> $d^2 = h^2 + 2hr$ => $r \approx 4000$ miles (radius of earth)

=> $d^2 = h^2 + 2(4000h)$

Eq 4 => $d^2 = h^2 + 8000h$ => take the square-root of both sides

=> $d = \sqrt{h^2 + 8000h}$

=> $d = \sqrt{h(h + 8000)}$ see Eq 1

[redacted] The writer of the equation on the document plugged in two different values of d^2 into Eq 4. The following two equations (Eq 5 and 6) were also hand-written on the document:

Eq 5 $2500 = h^2 + 8000h$

Eq 6 $h^2 + 8000h = 5000$

[redacted] The author of the document plugged values of 2500 and 5000 into d^2 of Eq 4 in order to get Eq 5 and Eq 6 above. These values (2500 and 5000) yield a distance from the "plane" to the point on the horizon (d) of 50 miles and 70.71 miles, respectively. It appears that the writer of the equation was attempting to calculate the height (h), or altitude, of the "plane" when the horizon (G) is 50 miles away and approximately 70 miles away. It is believed that the purpose of the equation is to provide the plane's altitude once a landmark on the ground appears on the horizon, 50 to 70 miles away. This would allow for a straight, constant, descending flight-path from that altitude to the horizon without any major deviations. According to [redacted] (P), the equation is a rough calculation, given that it neglects the complexities of terrestrial refraction. Terrestrial refraction occurs due to the density of the air, which varies with elevation. This variation in air density affects how light rays move through the air, which can affect how one observes something at a distance[i].

[redacted] The author of the document did not calculate the value of h on the document. Eq 5 and Eq 6 were solved for h by SA [redacted] (S) using the values of d^2 plugged in by the author of the document, see Eq 5 and 6 below:

Eq 5: $2500 = h^2 + 8000h$ => solve for h
h = 0.312 miles or 1,653 feet

Eq 6: $h^2 + 8000h = 5000$ => solve for h
h = 0.625 miles or 3,300 feet

[redacted] In addition to the equations and the definitions of the coefficients on the document, the following calculations were also written on the document:

Exhibit (Ex) 1:	52	44	44
	8-	25	25
	44	80	80
	76	76	
	225	20	
	20	245	
	245		

[redacted] The numbers in Ex 1 are basic addition and subtraction calculations. At this point, agents have been unable to connect these calculations to the written equations on the document. However, agents have a theory about what the numbers may represent based on a few assumptions. First, it is evident that the units of the equation in the document are miles per the author of the document whose intent of the equation seemed to be to calculate the height of a "plane". Second, given that the document was seized at the residence of BAYOUMI, and given his association with the hijackers of American Airlines (AA) Flight 77 from Dulles International Airport (Dulles) to Los Angeles International Airport (LAX), agents assumed that the numbers may be linked to Dulles and/or flight paths associated with Dulles and Flight 77.

[redacted] Based on those assumptions, agents looked at mileages associated with the flight path of AA Flight 77. Ex 1 shows that the number 20 was added to the number 225 after the fact. Agents found that the distance in nautical miles (nm) from Dulles to Reagan National Airport (Reagan) is approximately 20 nm. If in fact Ex 1 was a calculation of the distance in miles of AA Flight 77 from Dulles when the takeover occurred, it would make sense that 20 miles would be added to 225 in order to get a total mileage from the location of the plane to the Pentagon which is in close proximity to Reagan National Airport (Reagan).

[redacted] It is unclear if, or why, BAYOUMI would want to calculate the mileage from Dulles at the time of the takeover. This information may have helped provide the hijackers with a time/location that coordinated with the takeover of other planes on 9/11, or possibly provided a signal for all five hijackers on Flight 77 to prepare to take the plane. If this is the case, then there would have had to have been some sort of landmark on the ground that would have signaled that the mileage had been met, i.e. a river, mountain range, lake, etc.

[redacted] According to the National Transportation Safety Board, AA Flight 77's last transmission was approximately 08:51 and the plane changed course at approximately 08:55, about 275 miles from Dulles. Given an air-speed of 360 knots, the distance traveled by the plane during those four minutes of no radio communication before the plane changed course would have been approximately 25 miles, putting the takeover of Flight 77 as few as 250 miles from Dulles.

[redacted] Google Earth shows the following landmarks, which could possibly be visible from an altitude of 35,000 feet, at various distances from Dulles along the presumed flight path of Flight 77:

- Kanawha River (West Virginia), 245 miles from Dulles
- Elk Fork Lake (West Virginia), 225 miles from Dulles
- Ohio River, 231 miles from Dulles
- Route 77 through Ripley, WV, 230 miles from Dulles

[redacted] It is possible that any of these landmarks could have served as a signal of some sort to hijackers on the plane on the morning of 9/11. This landmark would have had to have been established ahead of time by somebody who would have had to have taken a "dry-run" in order to gather intelligence about Flight 77 before the attacks.

[redacted] FBI note: Some of the conclusions made about the calculations in Exhibit 1 were derived based on information provided by [redacted], a former [redacted] who was interviewed by FBI agents. His interview has been documented in an FD302, and is also included in its entirety below for reference purposes (see case [redacted]:

[redacted] On 03/05/2012, [redacted] (hereinafter referred to as [redacted]), date of birth [redacted], phone number [redacted] was interviewed by SA [redacted], SA [redacted] and SA [redacted] at a public restaurant in San Diego, California (CA). On a previous meeting with SA [redacted], [redacted] had been shown a handwritten document (hereinafter referred to as the document) that was seized pursuant to a search conducted by Metropolitan Police Service (MPS) in the United Kingdom at the residence of OMAR AL-BAYOUMI (BAYOUMI) in late September 2001. The document contained a handwritten equation along with other handwritten calculations. After being advised of the identities of the interviewing agents and that the purpose of the interview was to have [redacted] review the document again this time in conjunction with a theory developed by SA [redacted] and SA [redacted] [redacted] provided the following information:

To: Counterterrorism From: San Diego
Re: [redacted] [redacted] 04/05/2012

[redacted] [redacted] is a pilot who flew for the United States (U.S.) Navy for 20 years and commercially for American Airlines (AA) for 15 years. He retired from AA in July of 2001. [redacted] flew the AA Flight 77 from Dulles International Airport (Dulles) to Los Angeles International Airport (LAX) on several occasions. [redacted] had identified MOHAMED ATTA as a person posing as a pilot seated in one of the jump seats in the cockpit on one of his flights originating out of Boston. ATTA had asked a lot of questions about the instrumentation and specifically about changing course to New York. He also told [redacted] that he was going to mainline Delta to fly 767s. [redacted] thought that it was odd that a young pilot would go straight to flying 767s, since those spots are typically reserved for those with seniority.

[redacted] The first time [redacted] had reviewed the document, he had not seen any correlation between the equation on the document and piloting a plane. However, after reviewing the theory by SA [redacted] and SA [redacted] [redacted] admitted that Diagram 2, associated with the theory, provided him more insight into the equation and that it could be used to calculate a rate of descent when flying a plane.

[redacted] Given a distance from a target, the altitude at that location, and the current airspeed one could calculate the rate of descent and plug it into the computer on the plane in order to initiate a descent to that target. It would be reasonable to use the equation in the document in order to calculate the descent rate of an aircraft.

[redacted] All large airports have GPS plates located in their runways that send a signal to an aircraft relaying the latitude and longitude (GPS coordinates) of that runway. This signal provides pilots the information they need to set an accurate descent rate to the runway from a given location in the sky. However, if somebody wanted to land a plane at a location where there are no GPS plates, they would need to plug in a descent rate into the computer and they would need to know either the GPS coordinates of that location or how far the aircraft was from that location. With a known distance from a given location and the altitude of the plane, a descent rate could be calculated by the pilot. This calculation would have been done by hand since there is not a way for the plane's computer to perform this calculation. It is not likely that the use of the aircraft computer for navigation would not have been known by a person who had taken only minimal fight lesson, since that type of instruction was only taught in advanced training. In commercial aviation, a typical descent rate would be approximately 2,000 to 2,500 feet per minute.

[redacted] In 2001 it may have been difficult for an average citizen to establish the latitude and longitude of a certain location. As a pilot, [redacted] had access to a Mark 6 plotting board-map, which provided calculations based on a known location, where if the latitude and longitude of a certain location was known, then one could calculate the latitude and longitude of a nearby location using the this board-map. [redacted] [redacted] was familiar with the flight path between LAX and Dulles. Due to the air traffic in the vicinity of Dulles, not all planes taking off from Dulles would immediately climb to an altitude of 35,000 feet. It was not unusual for commercial flights out of Dulles to level off around 8,000 to 10,000 feet in that area for as far as 100 to 150 miles, in order to avoid traffic. The airspeed of a commercial airliner flying from Dulles to LAX would be approximately 360 to 380 nautical miles per hour (knots) due to head-winds experienced by an aircraft when flying west. However, from LAX to Dulles, a plane may experience tail-winds up to 120 to 140 knots, which would significantly increase the plane's airspeed going from west to east (FBI note: [redacted] was speaking of airspeed and not speed over the ground, where airspeed is the speed of the aircraft relative to the air, taking into consideration head-winds and tail-winds which can be significant at high altitudes). At an altitude of 8,000 to 10,000 feet, one would be able to see for approximately 100 miles on a clear day and even be able to identify various landmarks.

[redacted] As a pilot, [redacted] had access to maps that had the mileage listed on the legs between various waypoints along flight paths. These waypoints typically had a latitude and longitude associated with them. If one wanted to get the mileage (in nautical miles (nm)) along a flight path, one could either add the mileage of the legs between the waypoints or measure by hand the distance of the flight path. If he were to calculate the distance along a flight path by hand using these waypoints, he would have started from the beginning and not worked backwards starting from the destination. When measuring a distance by hand between waypoints on these maps, one could be accurate within 0.5 nm or better.

To: Counterterrorism From: San Diego
Re: [redacted] [redacted] (F), 04/05/2012

[redacted] In a case where a pilot would have to change a plane's course, such as on 9/11, the pilot would not necessarily need to disable the autopilot for this type of course redirection, and could even utilize autopilot after the change in course.

[redacted] [redacted] (P) could not think of any other reason for the equation given the parameters set forth on the document than to calculate a descent rate from a given altitude.

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i http://mintaka.sdsu.edu.GF/explain/atmos_refr/horizon.html