

March 9, 2020

Ms. Mary B. Neumayr, Chairwoman  
Mr. Stuart Levenbach, Senior Advisor to the Chairwoman  
Mr. Ted Boling, Associate Director for NEPA  
Mr. Michael Drummond, Deputy Associate Director for NEPA  
Ms. Amy Coyle, Senior Counsel  
Council on Environmental Quality  
730 Jackson Place NW  
Washington, DC 20503

**Re: Comment in Response to  
PRM: Update to the Regulations Implementing the Procedural Provisions of the  
National Environmental Policy Act**

**Attn: Docket No. CEQ-2019-0003**

Dear Ms. Neumayr and members of the Council on Environmental Quality:

On behalf of the undersigned individuals and organizations, we respectfully submit our comment in *opposition* to the Council on Environmental Quality's ("CEQ") proposed amendments to the CEQ regulations implementing the procedural provisions of the National Environmental Policy Act<sup>1</sup> ("NEPA") ("Proposed Amendments").

### **Executive Summary**

The undersigned primarily<sup>2</sup> object to the Proposed Amendments on the basis that the Proposed Amendments do not include orbital space in the vicinity of the Earth (e.g. near-Earth space) and its related concerns within the context and definition of the environment. Given nearly forty years elapsed since the regulations implementing the procedural provisions of NEPA were last thoroughly reviewed ("Implementing Regulations"),<sup>3</sup> we agree with the limited proposition that the Implementing Regulations need to be updated. However, despite the articulated objective to modernize the Implementing Regulations, we find the omission of near-Earth space and its

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<sup>1</sup> [42 U.S.C. §§ 4321, et seq.](#)

<sup>2</sup> At the public hearings on the Proposed Amendments, and no doubt in numerous written objections submitted since, other individuals and organizations raised many objections to many of the proposed changes. In this Comment, we choose to focus on one omission from the Proposed Amendments to which little attention has been directed. We do not address other aspects of the Proposed Amendments to which others have raised objections. That being said, the omission of these aspects in this Comment should not be attributed to the undersigned as either an approval or disapproval.

<sup>3</sup> [40 CFR §§ 1500-1508, 1515-1518.](#)

related concerns to be a significant oversight. In an era of substantial growth within the commercial space sector and satellite megaconstellations,<sup>4</sup> near-Earth space must necessarily be *explicitly* included as an integral component of the environment under NEPA and the Implementing Regulations. As the Proposed Amendments do not do so, we object to the present form of the Proposed Amendments and encourage the CEQ to include the proposed language below in any final amendments to the Implementing Regulations.

## Relevant Background

### *The Impetus*

There has long been the need to *expressly* include near-Earth space and its related concerns within the legal concept and definition of “human environment” under the Implementing Regulations. However, the realization of this need became most pronounced following SpaceX’s launch of its first set of sixty (60) Starlink<sup>5</sup> satellites on May 23, 2019 when many individuals observed the Starlink satellites cross the night sky:



Image used with permission of Marco Langbroek <https://sattrackcam.blogspot.com/>.<sup>6</sup>

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<sup>4</sup> Although there is no universally recognized definition of a “satellite megaconstellation”, the term is widely understood in the commercial space industry to mean groups of satellites numbering in the hundreds to thousands operated together, usually in similar orbits, for a common purpose such as relaying telecommunication signals at low latency over very large regions on Earth.

<sup>5</sup> A detailed description of the Starlink satellite mega constellation falls outside the scope of this Comment. For such information, one should review the “SpaceX Non-Geostationary Satellite System - Attachment A - Technical Information to Supplement Schedule S” filed by SpaceX in conjunction with its Starlink applications. See [https://licensing.fcc.gov/myibfs/download.do?attachment\\_key=1158350](https://licensing.fcc.gov/myibfs/download.do?attachment_key=1158350).

<sup>6</sup> The specific source for the image can be found at: <http://mlo.bz/F1jbf>.

As images of the satellites circulated on the Internet, concerns about satellite megaconstellations grew. As additional details emerged, these concerns became more pronounced.

All told, more than 45,000 new communications satellites may be launched into near-Earth space<sup>7</sup> in the coming decade.<sup>8</sup> Other novel uses of near-Earth space in the future may include the launches of untold numbers of orbital advertisements,<sup>9</sup> reflectors,<sup>10</sup> and other objects whose presence in orbit entails potential effects as seen from the ground. Thus, real concerns have emerged about the effects large satellite constellation systems and other uses of near-Earth space would have on the night sky.

### *The Regulatory Concern*

Given the attention to Starlink caused by its launch last May, questions arose as to how SpaceX obtained authorization for Starlink and the broader regulatory process.

As to the former question, SpaceX applied for and obtained authorization from the Federal Communications Commission (“FCC”) to operate its Starlink satellites. It did so by filing applications with the FCC that became available for public comment. Following the public comment period, the FCC approved the SpaceX Starlink applications. Of course, the FCC has approved applications by other companies including, but not limited to, OneWeb,<sup>11</sup> Telesat Canada,<sup>12</sup> and Space Norway.<sup>13</sup> Some commentators suggest that either SpaceX (and by inference any similarly situated company) or the FCC failed to adequately address environmental concerns under NEPA with respect to Starlink.<sup>14,15</sup> In fact, some contend these failures warrant

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<sup>7</sup> The orbital space in which commercial satellites operate range in mean height from  $\leq 2,000$  km, known as “Low Earth Orbit” or “LEO,” up to  $\sim 42,000$  km for satellites in geostationary orbits, or “GEO”.

<sup>8</sup> We count a total of at least 45,886 satellites among the publicly stated plans of SpaceX, OneWeb, and Amazon alone. Henry, C., *SpaceX submits paperwork for 30,000 more Starlink satellites*, SpaceNews, 2019, <https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/> (last visited March 10, 2020); Pultarova, T. and Henry, C., *OneWeb weighing 2,000 more satellites*, SpaceNews, 2017, <https://spacenews.com/oneweb-weighing-2000-more-satellites/> (last visited March 10, 2020); Shields, T., *Chasing SpaceX, Amazon Seeks to Launch 3,236 Internet Satellites*, Bloomberg, 2019, <https://www.bloomberg.com/news/articles/2019-07-05/amazon-asks-to-join-broadband-space-race-with-elon-musk-s-spacex> (last visited March 10, 2020).

<sup>9</sup> Christian, J., *This Startup Wants to Launch Giant Glowing Ads Into the Night Sky*, Futurism, 2019, <https://futurism.com/startrocket-giant-ads-night-sky-cubesats> (last visited March 10, 2020).

<sup>10</sup> Meixler, E., *China Plans to Launch an 'Artificial Moon' to Light Up the Night Skies*, TIME, 2018, <https://time.com/5429288/china-chengdu-artificial-moon/> (last visited March 10, 2020).

<sup>11</sup> [33 FCC Rcd 5366 \(6\)](#).

<sup>12</sup> [32 FCC Rcd 9663 \(11\)](#).

<sup>13</sup> [32 FCC Rcd 9649 \(11\)](#).

<sup>14</sup> O’Callaghan, J., *The FCC’s Approval of SpaceX’s Starlink Mega Constellation May Have Been Unlawful*, Scientific American, 2020, <https://www.scientificamerican.com/article/the-fccs-approval-of-spacexs-starlink-mega-constellation-may-have-been-unlawful/> (last visited March 10, 2020).

<sup>15</sup> Ryan, R., *Torts in Space: Are Commercial Satellite Operators Liable for Their Actions?*, VANDERBILT J. OF ENTERTAINMENT & TECHNOLOGY LAW, 2020.

litigation.<sup>16</sup> However, it has also been argued that, at this time, litigation would be misguided and efforts should be directed toward eliminating regulatory ambiguities.<sup>17</sup>

Regardless, a review of the applications and the related regulations reveals an explicit absence of near-Earth or orbital space from any environmental consideration.

### Section 1.1307

The relevant FCC applications inquire whether there would be any “significant environmental impact” as defined by [47 CFR § 1.1307](#).<sup>18</sup> Section 1.1307 constitutes a part of the FCC regulations promulgated in response to the CEQ Implementing Regulations.<sup>19</sup> At the time it promulgated § 1.1307, the FCC stated:<sup>20</sup>

*Based upon the Commission’s experience, we have determined that the telecommunications industry does not generally raise environmental concerns. The comments filed in this proceeding support the Commission’s determination. Thus, we have categorically excluded most Commission actions from environmental processing requirements.*

It further stated that:<sup>21</sup>

*The Commission has reduced to three general areas the types of actions that may have a significant environmental impact to include cases in which facilities: (1) Will be located in sensitive areas (e.g. wildlife preserves); (2) will involve high intensity lighting in residential areas; and/or (3) will expose workers or the general public to levels of radiofrequency radiation which would exceed the applicable health and safety standards set forth in § 1.1307(b) of our rules.*

Despite the FCC’s oversight of satellites, § 1.1307 makes no reference to the orbital space surrounding Earth.<sup>22</sup> And, it has not been amended since.<sup>23</sup>

In their applications, most, if not all, megaconstellation operators respond “No” to the question whether there existed any significant environmental impacts under § 1.1307.<sup>24</sup> Given the limited, terrestrial nature of the existing language in § 1.1307, it may come as no surprise that a respondent would not consider near-Earth space in answering the question as presented.

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<sup>16</sup> *Id.*

<sup>17</sup> Mudd, C., *Starlink and Mega Constellations: Finding a Viable Legal Solution*, Illinois State Bar Association Intellectual Property Newsletter, 2020 (available from the author).

<sup>18</sup> [Application for Satellite Space Station Authorizations, FCC 312 Main Form \(November 15, 2016\)](#).

<sup>19</sup> [47 CFR § 1.1307](#).

<sup>20</sup> [51 Fed. Reg. 14999](#).

<sup>21</sup> *Id.*

<sup>22</sup> [47 CFR § 1.1307](#).

<sup>23</sup> *Id.*

<sup>24</sup> Apart from conveying this “understanding,” the undersigned do not adopt a position on whether SpaceX accurately responded to the question or not.

## Assessing § 1.1307 Against the Implementing Regulations

As § 1.1307 represents the FCC's implementation of the CEQ NEPA Implementing Regulations, it makes sense to assess whether or not the Implementing Regulations encompass near-Earth space and its related concerns within the concept and definition of environment or "human environment." They do not *expressly* do so, nor do they *expressly exclude* it. Specifically, the CEQ Implementing Regulations provide:<sup>25</sup>

### **§ 1508.14 Human environment.**

*Human environment* shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment. (See the definition of "effects" ([§ 1508.8](#).) This means that economic or social effects are not intended by themselves to require preparation of an [environmental impact statement](#). When an [environmental impact statement](#) is prepared and economic or social and natural or physical environmental effects are interrelated, then the [environmental impact statement](#) will discuss all of these effects on the human environment.

The regulations further define "effects" as:<sup>26</sup>

### **§ 1508.8 Effects.**

*Effects* include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of [affected](#) ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

Based on the foregoing, the express omission of near-Earth space from these definitions inevitably leads to an interpretation that could reasonably omit near-Earth space from the necessary scope of environment under NEPA and the Implementing Regulations.<sup>27</sup> As such,

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<sup>25</sup> [40 CFR § 1508.14](#).

<sup>26</sup> [40 CFR § 1508.8](#).

<sup>27</sup> *See id.* and [40 CFR § 1508.14](#).

although the FCC should update § 1.1307 given more than thirty (30) years have elapsed, it cannot be said that § 1.1307 *fails* to comply with the Implementing Regulations with respect to inclusion of Earth’s orbital space. Rather, again, the focus should be on the failure of the Implementing Regulations to *expressly* include near-Earth space within the concept and definition of the applicable environment and environmental parameters.<sup>28</sup>

### CEQ Implementing Regulations Appropriate Focus

As stated above, the FCC should update § 1.1307. However, the FCC represents but one of several federal agencies with jurisdictions related to Earth’s orbital space.<sup>29</sup> The Federal Aviation Administration (“FAA”) regulates the launch and reentry of vehicles into space.<sup>30</sup> The FAA also regulates launch and reentry sites (e.g. spaceports).<sup>31</sup> The National Oceanic and Atmospheric Administration (“NOAA”) licenses and regulates commercial satellites directed toward and sensing aspects of Earth (“commercial remote sensing satellite systems”).<sup>32</sup> The Department of Commerce and Department of State regulate the export of sensitive information and technology that, among other categories, relate to space. All of these (and other) federal agencies must assess the environmental impact of their operations and matters falling within their respective jurisdictions pursuant to the CEQ Implementing Regulations.<sup>33</sup> Consequently, the Implementing Regulations become the logical source for a universal amendment to ensure the inclusion of near-Earth space and related concerns within the concept and definition of “human environment.”

### **Inclusion of near-Earth Space in Human Environment and Effects**

Near-Earth space has always constituted a critical component of the human environment. Given the Earth’s orbital space constitutes part of the human environment, it needs to be encompassed within the scope of the CEQ Implementing Regulations to ensure it – just as any other part of the environment – remains protected. Although there exist many concerns, this Comment focuses on four primary concerns related to protection of orbital space: human benefits of the dark night sky, optical and infrared astronomy, radio astronomy, and space debris.

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<sup>28</sup> To be very clear, we contend that near-Earth space implicitly falls within the existing scope of “human environment” and “effects” under the CEQ Implementing Regulations. *See id.* Indeed, we also contend this interpretation remains consistent with NEPA and its stated policy. However, the *express* omission of near-Earth space and its related concerns in the stated definitions creates ambiguity resulting in near-Earth space and its related concerns being overlooked as evidenced by the example discussed *supra* involving the FCC and the parties submitting applications thereto.

<sup>29</sup> This Comment does not address the myriad of proposals seeking to consolidate space related regulatory activities.

<sup>30</sup> Commercial Space Launch Act, 98 Stat. 3005, [Pub. L. No. 98-575](#) (Oct. 30, 1984) (re-codified as amended in 51 U.S.C. § 50901, *et seq.*); [14 C.F.R. §§ 400–450](#).

<sup>31</sup> *Id.*, particularly §§ 420 and 433; for the FAA guidance on the applicability of NEPA to these activities, [see FAA Order 1050.1F](#).

<sup>32</sup> [51 U.S.C. § 60121\(a\)](#); [15 CFR § 960](#).

<sup>33</sup> 40 CFR §§ [1500.2](#), [1500.3](#).

### *Human Benefits of the Dark Night Sky*

The night sky has figured prominently in the human experience for countless generations. It enabled timekeeping and navigation, inspired great works of art, music and literature, and beckoned examination that has led to deep insights about the nature of the universe. The night sky holds clear value to humanity for both aesthetic and scientific purposes. It is also an integral part of the landscape, day and night, and therefore has both visual and cultural resource values.<sup>34,35</sup> And while satellites have appeared in the Earth's night skies since the launch of Sputnik 1 in 1957, to date the numbers of visible satellites number in the low few hundreds. The landscape of planned expansion in the next few years into this realm by private, commercial space operators could result in tens of thousands of new objects, routinely bright enough to be seen by the unaided eye, resulting in significant and distracting changes to the 'viewshed' of the night sky. Unlike conventional sources of light pollution, such as skyglow associated with cities, the view of satellites cannot be evaded simply by traveling to more remote locations. These objects will be visible from everywhere on Earth, except possibly in its extreme polar regions.

### *Optical and Infrared Astronomy*

The presence of satellites and other orbital objects in the night sky potentially compromises astronomical observations by directing reflected sunlight toward telescopes where it competes with light from astronomical objects for detection. The impact of this effect scales according to the number of objects, the parameters of their orbits, time of night, and location on Earth. Satellites in Low-Earth Orbit are most visible during both evening and morning twilight. Visibility is greater in higher latitudes especially in summer, when satellites above the horizon remain illuminated by the Sun for longer. Telescopes with very large fields of view are most impacted, and those with small fields of view are impacted least. The degree of interference tends to scale with increasing exposure time, depending on the sensitivity of the imaging detectors. Predicted impacts range from as low as zero around midnight for some orbital parameters to as many as 40% of images taken by very wide-field telescopes during nautical twilight.<sup>36,37</sup> Evasive actions taken by observatories to avoid these impacts detract from operational efficiency. These satellites potentially affect every U.S. ground-based astronomy research facility, jeopardizing billions of dollars' worth of public investment.

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<sup>34</sup> Turina, F., [Protecting Night Skies and Naturally Dark Conditions in National Parks](#), in *VISUAL RESOURCE STEWARDSHIP CONFERENCE PROCEEDINGS: LANDSCAPE AND SEASCAPE MANAGEMENT IN A TIME OF CHANGE*, 186-200 (Gen. Tech. Rep. NRS-P-183, Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station) (Gobster, P.H., Smardon, R.C., eds., 2018).

<sup>35</sup> McCarty, J., et al., [New Directions and Common Challenges in Federal Stewardship of Visual Resources](#), in *VISUAL RESOURCE STEWARDSHIP CONFERENCE PROCEEDINGS: LANDSCAPE AND SEASCAPE MANAGEMENT IN A TIME OF CHANGE*, 9-16 (Gen. Tech. Rep. NRS-P-183, Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station) (Gobster, P.H., Smardon, R.C., eds., 2018).

<sup>36</sup> O. Hainaut and A. Williams, *Impact of satellite constellations on astronomical observations with ESO telescopes in the visible and infrared domains*, *ASTRONOMY AND ASTROPHYSICS*, 2020, in press. doi:[10.1051/0004-6361/202037501](https://doi.org/10.1051/0004-6361/202037501).

<sup>37</sup> "Given possible saturation of sensors well past astronomical twilight, during summer months there could be a 40% impact on twilight observing time – less in winter. Rubin Observatory would have to point to a place in the sky where briefly there were no LEO satellites [LEOsats]. We estimate one LEO satellite trail per three exposures of the LSST camera for the full Starlink constellation. Extrapolating to a more crowded sky in the mid-2020s, we must multiply by about three for the other LEOsat corporate plans (from FCC filings). Nearly every exposure within two hours of sunset or sunrise, on average, would have a LEOsat streak, and a few of those will be sufficiently bright to far exceed saturation of the CCD sensor." Rubin Observatory Project Science Team, [Impact on Optical Astronomy of LEO Satellite Constellation](#), Document-33805, 2020 (last revised March 3, 2020).

### *Radio Astronomy*

Functional satellites orbiting the Earth and communicating with ground stations pose a specific threat to radio astronomy facilities, whose extremely sensitive receivers can be damaged or destroyed by intense radio frequency (RF) emissions. Certain RF bands are set aside and protected from terrestrial emissions for the benefit of astronomy, including the establishment of National Radio Quiet Zones near radio observatories.<sup>38</sup> However, uncontrolled and spurious broadband communications and radar signals from space can substantially interfere with astronomical observations. The expected proliferation of orbital satellites emitting RF in coming years are a serious challenge to ground-based radio astronomy requiring adequate coordination between satellite operators and the astronomy community.<sup>39,40</sup>

### *Space Debris*

More than ten (10) years ago, Kessler identified large satellite constellations as “[s]ome of the most environmentally dangerous activities in space.”<sup>41</sup> Today, the same concerns exist.<sup>42,43</sup> More broadly, these concerns relate to effective space traffic management, avoiding collisions with satellites and space debris, mitigating and remediating space debris, and, managing end-of-life (“EOL”) and de-orbiting of space objects, to name but a few.

Objects in orbit around the Earth, other than functional satellites, are usually considered to be forms of debris. These include dead satellites, spent rocket stages, and literal debris either shed from other objects or generated as the result of collisions between objects. Debris objects impact both night sky visibility and professional astronomy observations. They reflect sunlight at optical wavelengths and emit thermally at infrared wavelengths. The objects range in size from many meters to less than a millimeter; objects larger than a few centimeters in size can be tracked from the ground, but the positions of the smallest objects are generally unknown. Small objects are of particular concern for this reason. Faint glints of sunlight reflected from them can be mistaken by ground-based telescopes for exotic, time-variable astrophysical phenomena, and their slow rates of motion can yield inappropriate detection triggers among sky surveys intended to find near-Earth objects that risk colliding with our planet.<sup>44</sup>

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<sup>38</sup> Federal Communications Commission (“FCC”) in Docket No. 11745 (November 19, 1958); Interdepartment Radio Advisory Committee (“IRAC”) in Document 3867/2 (March 26, 1958).

<sup>39</sup> With respect to Starlink, the FCC specifically required SpaceX to work with the NRAO to avoid conflict with the observatories listed in [47 CFR § 2.106](#) n. US131. [33 FCC Rcd 3391 \(4\)](#).

<sup>40</sup> The National Science Foundation (“NSF”) has established a radio spectrum management group, and has begun to also consider optical spectrum management.

<sup>41</sup> Kessler, D., *The Kessler Syndrome* (2009) (Self-published).

<sup>42</sup> See the Inter-Agency Space Debris Coordination Committee (“IADC”), <https://www.iadc-home.org/>; the United Nations Committee on the Peaceful Uses of Outer Space Scientific (“COPUOS”) and Technical Subcommittee, <https://www.unoosa.org/oosa/en/ourwork/topics/space-debris/index.html>; and the UN COPUOS Legal Subcommittee, <https://www.unoosa.org/oosa/en/ourwork/topics/space-debris/index.html>.

<sup>43</sup> United Nations Office for Outer Space Affairs (“UNOOSA”) staff have teamed with the International Astronomical Union (“IAU”) and the Instituto de Astrofísica de Canarias (“IAC”) to produce a white paper to be presented to the UN General Assembly as recommendations toward new international regulations.

<sup>44</sup> An example of this situation is discussed by Micheli, M., et al., *The observing campaign on the deep-space debris WT1190F as a test case for short-warning NEO impacts*, *Icarus*, 304, 4–8, 2018, doi:[10.1016/j.icarus.2017.10.006](https://doi.org/10.1016/j.icarus.2017.10.006).



Already over 22,300 debris objects exist with well-determined, regularly tracked orbits of which fewer than 10% are active satellites (statistical models estimate the existence of 34,000 debris objects larger than 10 cm, 900,000 debris objects between 1cm and 10cm, and 128,000,000 debris objects between 1mm and 1cm);<sup>45</sup> over time, we expect that the number and size distribution of objects will assume the form of a power law given that collisions generate large numbers of small pieces of debris, which then collide with other objects and increase the numbers of objects in a cascade effect.<sup>46</sup> Furthermore, space debris poses an existential threat to both public and private space assets, potentially including, e.g., meteorological satellites important to domestic weather forecasting and defense-related activities that impact U.S. national security.

### **Proposed Amendment to Implementing Regulations**

Given the foregoing, the undersigned respectfully submit that the CEQ should amend its Implementing Regulations to include near-Earth space and its related concerns within the scope and definition of environment. To that end, the undersigned specifically recommend that the Implementing Regulations be amended to include the following minimal additions:

#### *Existing Regulations*

[Amend]

#### § 1508.8 Effects:

*Effects* include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, **astronomical (such as the effects on human enjoyment of the observable dark sky, optical astronomy, radio astronomy, and space debris),**

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<sup>45</sup> European Space Agency, *Space Debris by the Numbers*, 2020 (data as of February 2020) [https://www.esa.int/Safety\\_Security/Space\\_Debris/Space\\_debris\\_by\\_the\\_numbers](https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers); see also UNOOSA Index of Objects Launched into Outer Space, [https://www.unoosa.org/oosa/osoindex/index.jsp?lf\\_id=](https://www.unoosa.org/oosa/osoindex/index.jsp?lf_id=).

<sup>46</sup> Kessler, D. J., & Cour-Palais, B. G., *Collision frequency of artificial satellites: The creation of a debris belt*, J. OF GEOPHYSICAL RESEARCH, 83(A6), 2637, 1978, doi:[10.1029/ja083ia06p02637](https://doi.org/10.1029/ja083ia06p02637).

historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

[Amend]

§ [1508.14](#) Human environment.

*Human Environment*<sup>47</sup> means comprehensively to include the natural and physical environment, **including Earth's orbital space**, and the relationship of people with that environment. (See the definition of "effects" ([§ 1508.8](#))). This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.

*Proposed Amendments*

Given the proposed amendment language to § [1500.3](#) in the proposed paragraph (a) that "[a]gency NEPA procedures to implement these regulations shall not impose additional procedures or requirements beyond those set forth in these regulations," it becomes imperative that CEQ Implementing Regulations be amended to include language encompassing orbital space and related concerns within any amendments adopted. To that end, the following proposed changes assume the amendments proposed by CEQ become adopted as written:

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<sup>47</sup> We note that the regulations' references (as opposed to other sources being quoted) to "man's environment" should be changed to "human environment" to be consistent with the applicable definitions (e.g. § [1502.16\(a\)\(3\)](#), as proposed).

[Amend]<sup>48</sup>

§ [1508.8](#)

[\* \* \* \* \*]

(g) Effects *or impacts* means effects of the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives. Effects include reasonably foreseeable effects that occur at the same time and place and may include reasonably foreseeable effects that are later in time or farther removed in distance.~~include:~~

~~(1a) Direct effects, which are caused by the action and occur at the same time and place.~~

~~(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.~~

~~Effects and impacts as used in these regulations are synonymous.~~ Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, **astronomical (such as the effects on human enjoyment of the observable dark sky, optical astronomy, radio astronomy, and space debris)**, historic, cultural, economic (such as the effects on employment), social, or health effects, ~~whether direct, indirect, or cumulative~~. Effects may also include those resulting from actions that ~~which~~ may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

(2) A “but for” causal relationship is insufficient to make an agency responsible for a particular effect under NEPA. Effects should not be considered significant if they are remote in time, geographically remote (**except with respect to Earth’s orbital space**), or the product of a lengthy causal chain. Effects do not include effects that the agency has no ability to prevent due to its limited statutory authority or would occur regardless of the proposed action. Analysis of cumulative effects is not required.

[\* \* \* \* \*]

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<sup>48</sup> The CEQ proposed amendments use a maroon color and the amendments proposed by this Comment use a red color in bold.

(m) *Human Environment*<sup>49</sup> means ~~shall be interpreted~~ comprehensively ~~to include~~ the natural and physical environment, **including Earth's orbital space**, and the relationship of present and future generations of Americans ~~people~~ with that environment. (See the definition of "effects." (§ 1508.8).) ~~This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.~~

In both cases, whether the existing regulations or those proposed by CEQ, the proposed amendments do not conflict with any existing portion of the regulations or NEPA.<sup>50</sup> Rather, they clarify the scope of our Earth environment and the effects upon it.

Indeed, as the Implementing Regulations currently state:

*Human environment* shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment.

When one considers the "ordinary, contemporary, common meaning" of natural,<sup>51</sup> the "natural environment" includes the "external world in its entirety."<sup>52</sup> Thus, "human environment" encompasses the external world and humankind's interaction with it. In the context of space, this necessarily includes both the effects objects in space have on terrestrial Earth as well as the space such objects inhabit.

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<sup>49</sup> We note that the regulations' references (as opposed to other sources being quoted) to "man's environment" should be changed to "human environment" to be consistent with the applicable definitions (eg § [1502.16\(a\)\(3\)](#), as proposed).

<sup>50</sup> See [40 CFR §§ 1500-1508, 1515-1518](#); [42 U.S.C. §§ 4321](#), et seq.

<sup>51</sup> *Perrin v. United States*, 444 U.S. 37, 42, 100 S. Ct. 311 (1979). ("A fundamental canon of statutory construction is that, unless otherwise defined, words will be interpreted as taking their ordinary, contemporary, common meaning."); *United States v. Bell*, 936 F.2d 337, 342 (7th Cir. 1991).

<sup>52</sup> <https://www.merriam-webster.com/dictionary/nature>.

## Conclusion

For millennia, humankind enjoyed and used the dark night sky to navigate, for ceremonial and religious purposes, to explore the secrets of the Universe, and, quite simply, enjoy the astronomical environment in which Earth resides. As the commercial space industry grows and our use of the orbital space around Earth increases, we must ensure – the CEQ must ensure – that federal agencies include Earth’s astronomical and orbital space within the environment for purposes of complying with NEPA, the CEQ Implementing Regulations, and the agencies’ regulations. Consequently, the undersigned (a) agree the Implementing Regulations need to be modernized to effectuate this purpose but (b) must oppose the proposed amendments because they do not do so. To that end, the undersigned propose specific amendments that will sufficiently satisfy the concerns raised herein at this time and under these circumstances.

Sincerely,



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Principal Attorney and Owner  
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**Ruskin Hartley**  
Executive Director  
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Mudd Law represents domestic and international clients in diverse litigation and transactional matters with offices in Chicago, Houston, and Park City. With nearly two decades of practice across the United States, it has become recognized as a leader in Internet and technology law. Several years ago, the Firm expanded its practice into space law and policy. More information about Mudd Law and its representation of clients in the commercial space industry and space policy initiatives can be found at <http://www.muddlaw.com>.

The International Dark Sky Association, a 501(c)(3) nonprofit organization based in Tucson, Arizona, advocates for the protection of the nighttime environment and dark night skies by educating policymakers and the public about night sky conservation and promoting environmentally responsible outdoor lighting. More information about IDA and its mission may be found at <http://www.darksky.org>.

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