Attachment 2

FHWA-VDOT

Programmatic Agreement for Project-Level Air Quality Analyses for Carbon Monoxide

(Based on the 2015 NCHRP 25-25 Task 78 Template)

April 2016

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This Programmatic Agreement (PA) between the Virginia Department of Transportation (VDOT) and the Virginia Division of the Federal Highway Administration (FHWA Virginia Division) specifies terms for screening highway projects for potential carbon monoxide (CO) impacts that are currently undergoing environmental studies to meet requirements of the National Environmental Policy Act (NEPA). This PA establishes the types of projects and project conditions that will not require project-specific modeling or a quantitative air quality analysis to document that they do not cause a violation of the National Ambient Air Quality Standards (NAAQS) for CO. Rather, these project types and conditions will require only a general qualitative statement to meet project-level air quality requirements that references this agreement and the associated technical support document (TSD), which presents worst-case modeling results for CO that would cover the specific project type and condition.

Basis of Agreement: This PA was developed based on an extensive history of modeling potential CO impacts for highway projects. In support of its transportation program, VDOT has been performing CO emissions analyses of highway projects for decades. These analyses have not resulted in identification of violations of CO air quality standards as a result of the completion of a highway project. As evidenced by ongoing reductions in monitored ambient CO concentrations and the continuing implementation of the Federal Motor Vehicle Emission Control Program, future project-level CO analyses are expected to find little, if any, possibility of potential violations of CO ambient air quality standards caused by the completion of a highway project.

Recent efforts at the national level reinforce this conclusion. The *Federal Highway Administration (FHWA) Carbon Monoxide (CO) Categorical Hot-Spot Finding* (FHWA, February, 2014)[1] documented conditions for urban intersections in CO maintenance areas that did not require a specific project-level conformity determination but could rely on the categorical finding to make a project-level conformity determination. Similarly, the National Cooperative Highway Research Project (NCHRP) study: *Programmatic Agreements for Project-Level Air Quality Analyses (2015)*[2], which provides the primary basis for this agreement, built upon the technical analysis presented in the 2014 categorical finding and examined a wider variety of project types and conditions in order to identify those project types and conditions that could not result in violation of current CO ambient air quality standards. These studies tested the remote possibility of a CO ambient air quality standard violation using worst-case modeling and following appropriate EPA guidance for modeling CO hot-spots (e.g., *Guideline for Modeling Carbon Monoxide from Roadway Intersections*, U. S. EPA, EPA-454/R-92-005, November 1992;

[1] See: http://www.fhwa.dot.gov/environment/air_quality/conformity/policy_and_guidance/cmcf/

[2] ICF International, Zamurs and Associates LLC, and Volpe Transportation Systems Center, "*Programmatic Agreements for Project-Level Air Quality Analyses*", NCHRP 25-25 (78), 2015. See: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3311

Using MOVES in Project-Level Carbon Monoxide Analyses, U.S.EPA, EPA-420-C-10-041 December 2010). The studies also used EPA-approved emission and dispersion models (MOVES2010b as the emission model and CAL3QHC (version 04244) as the dispersion model).

Relationship of this Agreement to Prior FHWA-VDOT Agreements: With an exception for the threshold criteria established for skewed intersections, this PA supersedes the 2009 PA executed between FHWA and VDOT for project-level air quality (CO) analyses. The NCHRP template on which this PA was based did not include modeling of skewed intersections but left that to the states. Therefore, for purposes of continuity and to not diminish the applicability and utility of this PA relative to the previous (2009) PA, the threshold criteria (design year traffic volumes) for skewed intersections that were established in the 2009 PA are incorporated into this PA by reference and continue to be applicable for NEPA purposes until such time as this PA is updated to include skewed intersections.

Relationship to the VDOT Resource Document: Nothing in this PA precludes or is intended to preclude the application of the models, methods, protocols, assumptions and data specified or otherwise referenced in the VDOT Resource Document and its associated online data repository and their respective future updates.

Application of the PA:

1. For the project type and condition of interest, determine from the attached tables (Table 1 for freeways and arterials, Table 2 for intersections, and Table 3 for interchanges), whether a one-hour concentration value is listed. Since the ambient concentrations presented in these tables are based on national-level modeling and are not state-specific, adjustments to the listed concentrations are needed to apply the results for Virginia. Therefore:
    a. If a one-hour concentration is <u>not</u> listed, project-specific modeling is needed.
    b. If a one-hour concentration is listed, then proceed to step 2 to adjust the results for application in Virginia.

2. The one-hour concentration listed in the tables below is for the project contribution only. Therefore:
    a. To determine the worst-case one-hour concentration for comparison to the applicable NAAQS, use the following equation with values for Virginia for background concentration:
    One-hour concentration (ppm) = One-Hour concentration from the table + Local Background Concentration (One-Hour) (as specified by or in association with the VDOT Resource Document)

    b. To determine the corresponding worst-case eight-hour concentration for comparison to the NAAQS, use the following equation with values for Virginia for background concentration and persistence factor:
    Eight-hour concentration (ppm) = One-Hour concentration from the table x Local

Persistence Factor (as specified by or in association with the VDOT Resource Document)
+ Local Background Concentration (Eight-Hour) (as specified by or in association with the VDOT Resource Document)

3. Compare the calculated one- and eight-hour concentrations to the applicable NAAQS. If both concentrations are less than the applicable NAAQS, then the project is covered by the PA. The eight-hour NAAQS is typically the limiting value.

4. If the project is covered by the PA with the adjusted persistence factor and/or background concentrations, the qualitative text provided at the end of the PA should be included (modified if needed for the project) in the project record and relevant environmental documents.

Project Types and Conditions: This PA applies to the following project types and associated project conditions:

Freeways and Arterials

Table 1, attached, shows the conditions that were identified in the 2015 NCHRP study for urban and rural arterials and freeways that would meet the one- and eight-hour NAAQS and would be covered by this PA[3]. The table shows one-hour concentrations, not including background concentrations. The populated cells of the table correspond to the lane and grade combinations for arterials and freeways that, even under worst-case conditions, would not result in exceedances of the 8-hour NAAQS for CO based on national level modeling. Where the table entries are blank, the corresponding configuration would *not* meet the NAAQS based on national-level worst-case modeling and would *not* be covered by this PA. Project-specific modeling would typically need to be conducted to show compliance with the NAAQS in these cases.

For example, for a transportation improvement project for a freeway for which the build scenario has 10 total lanes, average road grades of 2% or less, and peak hour (congested) operating speeds of 50 mph, Table 1 shows a worst-case contribution of 8.0 ppm for the one-hour CO standard based on national-level modeling. To determine the corresponding worst-case concentration for Virginia specifically, follow the procedure given in the section "*Application of the PA*" above. If the concentration so adjusted for Virginia is still below the applicable NAAQS, then the project is covered by this PA and does *not* require project-specific modeling for CO.

[3] These findings apply to scenarios with average speed ranging from 45 to 56 mph for arterials and 19 to 74 mph for freeways.

Conversely, the same freeway with 12-lanes would *not* be covered by this PA, as the table entry is blank for that configuration. No adjustment for Virginia-specific conditions is available in these cases.

The values shown in Table 1 were determined in the 2015 NCHRP study using conservative or worst-case modeling inputs and assumptions for MOVES and CAL3QHC (see Technical Approach discussion, below). Concentrations for comparison to the eight-hour NAAQS were determined from the one-hour values shown using a national average eight-hour background concentration of 2.6 ppm along with the EPA recommended persistence factor of 0.7. The resulting eight-hour concentrations were used to identify which arterial and freeway configurations would meet the eight-hour NAAQS. For application of the PA in Virginia, the corresponding concentrations for Virginia are determined by substituting Virginia-specific background concentrations and persistence factors.

Note: this PA covers lanes widths of 11 feet or more for freeway and arterial project types.

Intersections

Intersections were examined using the same approach (other than geometrics) as in freeway and arterial cases. That is, the same MOVES and CAL3QHC model inputs and assumptions were used. The intersection analysis assumes six approach lanes on each leg of the intersection, with two of the approach lanes becoming left-turn lanes at the intersection. Four lanes are assumed on each departure leg. The intersection case was modeled at a grade of 2%.

Table 2, attached, shows the maximum 1-hour CO concentrations for urban and rural intersections that, with the national-level modeling defaults of an 8-hour CO background level of 2.6 ppm and a persistence factor of 0.7, do not produce worst-case modeled CO concentrations that could result in exceedances of the 8-hour CO NAAQS. For application of the PA in Virginia, the corresponding concentrations for Virginia are determined by substituting Virginia-specific background concentrations and persistence factors.

For example, for a transportation improvement project for an urban intersection with a grade of 2% or less, six approach lanes or less, and forecast approach speeds not less than 15 mph, Table 2 shows a worst-case contribution of 6.5 ppm for the one-hour CO standard based on national level modeling. The corresponding worst-case concentrations for Virginia are obtained by following the procedure given in the section "*Application of the PA*" above and compared to the applicable NAAQS to determine compliance. If the applicable NAAQS are met, the project would be covered by this PA and not require project-specific CO modeling to demonstrate compliance with the CO NAAQS.

Conversely a project with seven approach lanes, a 3% grade and/or a 10 mph approach speed would *not* be covered by this PA, as the table entry is blank for that configuration. No adjustment for Virginia-specific conditions is available in these cases. Project-specific modeling would be needed to show compliance with the NAAQS.

Notes:

1) Highly congested intersections (where the approach speed is less than 15 mph) are not included in this PA.
2) While intersections with five or more legs are not explicitly included in this PA, reasonable inferences may be made for their inclusion by combining legs and using the thresholds established for skewed angles (see next item).
3) For this PA, the intersections were modeled as 90 degree intersections, that is, with roadways intersecting at right angles. Therefore, as noted above under "*Relationship of this Agreement to Prior FHWA-VDOT Agreements*", the thresholds and supporting worst-case modeling for skewed intersections (those whose approaches do not intersect at right angles) as modeled for the 2009 FHWA-VDOT PA are incorporated into this agreement by reference.

Interchanges with an Adjacent Intersection

In the 2015 NCHRP study, interchanges were analyzed using the MOVES and CAL3QHC models, with the same traffic inputs and assumptions as in the previous cases. The interchange scenarios were modeled at a 0% grade in an urban location. The total number of interchange lanes analyzed ranged from 2 to 22 in 2 lane increments. For the adjacent intersection, a variety of distances from the edge of the nearest freeway travel lane to the edge of the nearest travel lane on the interchange ramp (at the intersection) were also examined. The geometry of the adjacent intersection was also modeled as having six approach lanes, including two left turn lanes, and four departure lanes.

Note: This is a very conservative approach for ramp intersections adjacent to freeway interchanges, which typically have only one- or two-lane ramps approaching or departing from the intersection.

Table 3, attached, shows the maximum 1-hour CO concentrations for these interchange scenarios that, with the applied 8-hour CO background level and persistence factor, do not produce modeled concentrations that could result in exceedances of the 8-hour CO NAAQS, based on national-level modeling. For application of the PA in Virginia, the corresponding worst-case concentrations for Virginia are determined by substituting Virginia-specific background concentrations and persistence factors. Where the table entries are blank, the corresponding configuration would *not* meet the NAAQS based on worst-case modeling and would *not* be covered by this PA. Project-specific modeling would typically be needed to show compliance with the NAAQS in these cases.

For example, looking at the first section of Table 3 for which approach speeds are not less than 15 mph, a 12-lane freeway with an adjacent intersection that is located not less than 150 feet from the nearest edge of the freeway lanes has a worst-case one-hour CO concentration listed of 9.1 ppm. The corresponding worst-case concentrations for Virginia may be obtained by following the procedure given in the section "*Application of the PA*" above and compared to the applicable NAAQS to determine compliance. If the applicable NAAQS are met, the project would be covered by this PA and not require project-specific modeling.

Conversely, the table entry is blank for a 14 lane freeway with an intersection at 150 feet that has an approach speed of not less than 15 mph. Thus, that configuration would *not* be covered by this PA. No adjustment for Virginia-specific conditions is available in this case.

General Terms

Deference to Professional Judgment on Determinations of Substantive Differences: Consistent with our agreement for revising air studies, under this PA, FHWA will defer to the professional judgment of VDOT air quality staff to apply the agreement for projects that are substantively (as defined in the Resource Document) consistent with the project types and configurations specified in this agreement. For example, if an intersection is slightly skewed, this PA may be applied using the criteria for square intersections if the difference is not substantive in the professional opinion of VDOT Air Quality staff and therefore not expected to result in a modeled exceedance of the applicable NAAQS.

Projects of De Minimis Scope or Expected Impact: Consistent with the Protocol 2.5.3.1 of the VDOT Resource Document, "*Modeling or analyses (qualitative or quantitative) are only conducted for projects that change (add, delete, relocate or otherwise modify) roadway capacity, intermodal facilities, and/or transit service in areas with significant traffic volume*." Conversely, projects that do not change (add, delete, relocate, or otherwise modify) roadway capacity, intermodal facilities, and/or transit service (i.e., are of de minimis scope or expected impact) do not require either qualitative or quantitative project-level air quality analyses.

Exempt Projects: Projects that would qualify as exempt under one or more of the categories specified in the federal transportation conformity rule (whether or not conformity applies for the area in which the project is located) do not, under this agreement, require project-specific modeling for CO for purposes of NEPA. In these cases, a qualitative statement as provided below for exempt projects is to be included in the project environmental document or record.

Mutual Applicability of the PA and the FHWA Categorical Finding for CO[4]: As supported by protocols established in the VDOT Resource Document, which was subjected to inter-agency consultation for conformity purposes in December 2015, and under this agreement, VDOT at its discretion may apply this PA and the FHWA categorical finding for CO either individually or together (without one limiting the utility of the other in clearing projects) for projects located in Virginia.

- By the protocol established in section 3.2.3 (*Application of Programmatic Agreements for Conformity Purposes*) of the VDOT Resource Document, this PA is also applicable for projects subject to transportation conformity requirements for CO.

[4] See: http://www.fhwa.dot.gov/environment/air_quality/conformity/policy_and_guidance/cmcf/hotspot_memo.cfm

- By the protocol established in section 4.2.3 (*Application of Categorical Findings for Purposes of NEPA*) of the VDOT Resource Document, projects that meet the technical criteria specified in a categorical finding or findings may also be cleared for purposes of NEPA for the pollutant(s) for which the criteria are met. Note the application of a US DOT or FHWA categorical finding is not intended to and does not in any way limit the applicability of this or any other PA between FHWA and VDOT.

Project Alternatives: This PA is intended to cover all build alternatives for the above-listed project types, as well as the no-build alternative. If one or more alternatives are not included in the list of project types above, VDOT and FHWA Virginia Division will coordinate to determine the applicability of the PA to that alternative(s). It may be that one alternative that is covered by the PA would effectively represent the worst-case for all of the alternatives, e.g., if one alternative has more congested conditions than the others.

Locally Administered Projects: This PA may also be applied for locally administered projects in Virginia. For the project's environmental document or record, the local agency will include a statement that the project under review meets the project types and conditions covered in the PA (including data and information as necessary to support that determination) and will conclude with one of the statements (or a similar statement, as appropriate to the project) provided in the *Administrative Record* section below.

Project Types Not Covered by This PA: Examples of project types that are not specifically covered by this PA include but are not limited to: park and ride lots, parking garages, new intermodal transfer yards, tunnels, intersections that have more than four legs, and intersections with approach speeds less than 15 mph. If a project type is not covered by the PA, project-specific air quality modeling may be needed. For those project types and conditions where applicability of this PA is not certain, VDOT and FHWA Virginia Division will coordinate to determine its applicability.

Discretionary Modeling of Projects Otherwise Covered by this PA: This PA does not preclude VDOT from conducting, at its discretion, project-specific modeling for CO for any project, even if the project would otherwise meet the criteria established in this agreement and therefore not require such modeling. Examples of such projects include (but are not limited to) ones for which an environmental impact statement (EIS) is being prepared and ones that may be considered higher profile, i.e., that involve or may involve a greater degree of public and/or stakeholder interest.

Years of Analysis: This PA is based on modeling for a project opening year of 2015, so it covers projects of the types and conditions listed above whose opening year (year of completion) is 2015 or later.

Technical Approach: The modeling conducted in support of this PA is described in detail in the accompanying TSD. In general, a worst-case modeling approach was applied following EPA guidance. EPA's MOVES2010b emission model and CAL3QHC (version 04244) dispersion model

were applied. EPA's current guidance for modeling CO Hot-Spots (*Guideline for Modeling Carbon Monoxide from Roadway Intersections*, U. S. EPA, EPA-454/R-92-005, November 1992) was also applied.

The assumptions and inputs used in the model were worst-case or highly conservative, leading to higher emission estimates and less dispersion (and therefore greater forecast ambient concentrations) than would be expected under real-world conditions. Consequently, if a project does not cause a modeled exceedance of the NAAQS with these worst-case or conservative inputs and assumptions, then it may be stated with high confidence that an exceedance under real-world conditions would not be expected.

Finally, VDOT consulted with the Virginia Department of Environmental Quality (VDEQ) in the development of its Resource Document, which includes separate memoranda documenting background concentrations and persistence factors to be applied for projects in Virginia. These values are used under this PA to arrive at an eight-hour total CO concentration for comparison with the eight-hour CO NAAQS.

Administrative Record: For the project's environmental document or record, VDOT will include a statement that the project under review meets the project types and conditions covered in the PA (providing data and/or information as necessary to support that determination) and will conclude with one of the following statements (or a similar statement, as appropriate to the project):

> *Projects that qualify as exempt and/or for Programmatic Categorical Exclusions:*
> The project is identified as being exempt from the requirement to determine conformity according to the federal transportation conformity rule and/or qualifies for a Programmatic Categorical Exclusion (PCE) according to the PCE Agreement in effect between the Federal Highway Administration and the Virginia Department of Transportation. Accordingly, it is concluded that the project would not significantly impact air quality and would not cause or contribute to a new violation, increase the frequency or severity of an existing violation, or delay timely attainment of any National Ambient Air Quality Standard.
>
> *Projects that meet the terms of this PA*:
> The project is consistent with (and does not exceed) the project types and conditions listed in the agreement between the Federal Highway Administration and the Virginia Department of Transportation for streamlining the project-level air quality analysis process for carbon monoxide. Modeling using "worst-case" parameters has been conducted for these project types and conditions. It has been determined that projects such as this one would not significantly impact air quality and would not cause or contribute to a new violation, increase the frequency or severity of an existing violation, or delay timely attainment of the National Ambient Air Quality Standard for carbon monoxide.

or

"An air quality analysis is not necessary as this project will not increase traffic volumes, reduce source-receptor distances, or change other existing conditions to such a degree as to jeopardize attainment of the national ambient air quality standard for carbon monoxide."

Future Revisions: VDOT and FHWA Virginia Division recognize that the applicable NAAQS and/or project level air quality analysis methodologies may change over time. The latter may include new or updated emission or dispersion models, background CO levels, and/or associated worst-case modeling assumptions. VDOT will consult as appropriate with FHWA Virginia Division regarding any changes that may be recommended as a result.

Termination of Agreement: Should either VDOT or FHWA Virginia Division determine that it is necessary to terminate the PA, they may do so by written notification to the other party. The PA will terminate 30 days after the date of the notification. Projects that have been cleared on the basis of the PA before the effective termination date may maintain that clearance and not require project-specific modeling for CO.

Value of the PA: The PA is beneficial to both VDOT and FHWA Virginia Division. It reduces costs by eliminating unnecessary analyses, enhances efficiency and certainty in the environmental review process, and helps ensure project scope and scheduling.

Attachment to the Programmatic Agreement

Table 1. One-hour CO concentrations (ppm) for freeways and arterials[1] in urban and rural locations of varying lane and grade configuration (not including background concentrations)

			GRADE			
FACILITY TYPE	**LOCATION**	**LANES**	**0**	**2**	**4**	**7**
Arterial	Urban	12	6.7	8.5		
Arterial	Urban	10	6.0	7.6		
Arterial	Urban	8	5.2	6.6		
Arterial	Urban	6	4.3	5.4	7.5	
Arterial	Urban	4	3.2	3.9	5.5	
Arterial	Urban	2	1.8	2.2	3.0	
Arterial	Rural	8	8.7			
Arterial	Rural	6	7.2	8.6		
Arterial	Rural	4	5.4	6.3	8.6	
Arterial	Rural	2	3.1	3.6	4.9	
Freeway	Urban	20	9.0			
Freeway	Urban	18	8.6			
Freeway	Urban	16	7.9			
Freeway	Urban	14	7.2			

			GRADE			
Freeway	Urban	12	6.5			
Freeway	Urban	10	5.6	8.0		
Freeway	Urban	8	4.7	6.6		
Freeway	Urban	6	3.7	5.1	7.2	
Freeway	Urban	4	2.7	3.5	4.9	6.2
Freeway	Urban	2	1.4	1.7	2.4	3.1
Freeway	Rural	8	8.0			
Freeway	Rural	6	6.4	8.6		
Freeway	Rural	4	4.5	5.9	8.2	
Freeway	Rural	2	2.4	3.0	4.2	5.3

[1]These findings apply to scenarios with average speed ranging from 45 to 56 mph for arterials and 19 to 74 mph for freeways

Table 2. One-hour CO concentrations (not including background concentrations) for rural and urban intersections at varying approach speeds for a six approach lane intersection for each leg at two percent grade.

LOCATION	APPROACH SPEED (MPH)	CONCENTRATION (PPM)
Urban	15	6.5
Urban	25	5.7
Urban	35	5.2
Rural	25	8.8
Rural	35	8.4

Table 3. One-hour CO concentrations at varying intersection approach speeds at varying distances from an urban freeway at varying lane configurations (not including background concentrations)

Urban Freeway Contribution of CO (PPM) at 15 mph Approach Speed with Increasing Distance from Freeway Pavement Edge (ft)												
NUMBER OF LANES	**10**	**20**	**30**	**60**	**80**	**100**	**125**	**150**	**175**	**300**	**500**	**1000**
2	8.5	7.8	7.5	7.1	6.9	6.7	6.7	6.6	6.5	6.5	6.3	6.3
4			8.8	8	7.6	7.4	7.2	7.1	7.1	6.7	6.5	6.3
6				8.9	8.4	8.1	7.9	7.6	7.6	7.1	6.8	6.5
8					9.1	8.7	8.4	8.1	8	7.4	7.1	6.7
10							9	8.7	8.5	7.8	7.3	6.8
12								9.1	8.9	8.1	7.6	6.9
14										8.5	7.8	7.1
16										8.8	8	7.2
18										9.1	8.2	7.4
20											8.5	7.5
22											8.7	7.6

Urban Freeway Contribution of CO (PPM) at 25 mph Approach Speed with Increasing Distance from Freeway Pavement Edge (ft)												
NUMBER OF LANES	**10**	**20**	**30**	**60**	**80**	**100**	**125**	**150**	**175**	**300**	**500**	**1000**
2	7.9	7.2	6.9	6.5	6.3	6.1	6.1	6	5.9	5.9	5.7	5.7
4		8.7	8.2	7.4	7	6.8	6.6	6.5	6.5	6.1	5.9	5.7
6				8.3	7.8	7.5	7.3	7	7	6.5	6.2	5.9
8				9.1	8.5	8.1	7.8	7.5	7.4	6.8	6.5	6.1
10					9.1	8.7	8.4	8.1	7.9	7.2	6.7	6.2
12							8.8	8.5	8.3	7.5	7	6.3
14								9	8.7	7.9	7.2	6.5
16									9.1	8.2	7.4	6.6
18										8.5	7.6	6.8
20										8.7	7.9	6.9
22										9.1	8.1	7

Urban Freeway Contribution of CO (PPM) at 35 mph Approach Speed with Increasing Distance from Freeway Pavement Edge (ft)												
NUMBER OF LANES	**10**	**20**	**30**	**60**	**80**	**100**	**125**	**150**	**175**	**300**	**500**	**1000**
2	7.3	6.6	6.3	5.9	5.7	5.5	5.5	5.4	5.3	5.3	5.1	5.1
4	9	8.1	7.6	6.8	6.4	6.2	6	5.9	5.9	5.5	5.3	5.1
6			8.6	7.7	7.2	6.9	6.7	6.4	6.4	5.9	5.6	5.3
8				8.5	7.9	7.5	7.2	6.9	6.8	6.2	5.9	5.5
10					8.5	8.1	7.8	7.5	7.3	6.6	6.1	5.6
12						8.7	8.2	7.9	7.7	6.9	6.4	5.7
14							8.8	8.4	8.1	7.3	6.6	5.9
16								8.9	8.5	7.6	6.8	6
18									8.9	7.9	7	6.2
20										8.1	7.3	6.3
22										8.5	7.5	6.4