APPENDIX M—FLUID MINERAL REASONABLY FORESEEABLE DEVELOPMENT

I. INTRODUCTION

The Reasonably Foreseeable Development (RFD) scenarios outlined in this Environmental Impact Statement (EIS) are the Bureau of Land Management (BLM) estimates of the foreseeable oil and gas activities that could result from making public lands within a planning area available for future oil and gas leasing, as determined by the collective decisions and mitigation comprising each alternative analyzed in a land use plan. The RFD scenario does not establish a threshold for future federal leasing, exploration, or development activities. Rather, it is a scenario of actual and hypothetical activities that could result from implementing each of the alternatives and corresponding mitigation. These projected activities enable BLM to conduct an impact analysis to qualify and quantify impacts that could result from making public land available for future leasing under the constraints of each alternative. The potential impacts are then available to the decisionmaker for consideration in reaching a final judgment on which lands to make available and subject to mitigation.

The RFD scenario for the Price Resource Management Plan (RMP) identifies future exploration and development activities that can be reasonably expected to occur within the Price Field Office (PFO) planning area based on the allocation decisions, objectives, and management actions for each alternative analyzed, including the Proposed RMP. Because the Price RMP was initiated 3 years before BLM Interim Management Plan (IM) 2004-089 was adopted, the Price RFD scenario does not meet the requirements set forth by this guidance. To be precise, the RFD does not include a scenario based on the assumption that "all potentially productive areas are open under standard lease terms and conditions." There is, however, an RFD scenario for each alternative analyzed in detail. The corresponding impact analysis, like the RFD, reflects the constraints of the various goals, objectives, and management actions that comprise each alternative. The RFD meets or exceeds all other applicable guidance. The analyses for various RFD scenarios ensure that the decisionmaker is knowledgeable about the range of potential effects of making public lands within the PFO area available for oil and gas leasing.

Although BLM has no control over exploration or development activities on private or State lands, the Price RFD scenario identifies the estimated surface disturbance for all significant reasonably foreseeable oil and gas activities within the planning area (BLM, U.S. Forest Service [USFS], State of Utah, and private) during the next 15–20 years. The Price RFD scenario focuses on the estimated acres of surface disturbance from the construction of oil and gas well pads, roads, pipelines, and other reasonable impact assumptions based on past and present activities. The Price RFD scenario cannot, however, be considered a limiting factor for the number of wells drilled, the acres disturbed, or any other potential authorizations. The projected number of well pads is an estimate for analyzing potential impacts to other resources and resource uses that could result from the development of existing leases and any future leases that may be issued as a result of implementing an analyzed alternative. The number of wells per well pad is not limited by the Price RFD scenario.

The impact analysis of implementing any one of the alternatives is developed and analyzed in the context of lands currently under lease, including the direct, indirect, and cumulative impacts associated with valid existing rights and any imposed mitigation. Future Environmental Assessments (EA) and EISs for exploration and development of oil and gas resources will be tiered to this Proposed RMP/Final EIS analysis and will, at a minimum, refine the RFD scenario. For example, full field development analyses conducted 10 years from now may amend or supplement the RMP/EIS because development and impact

scenarios differ from those described in this document. Different on-the-ground conditions, more comprehensive resource information, improved technologies, and improved mitigation will probably also be factors for future consideration. The RFD scenario is a tool for analyzing the effects of making public lands available for leasing based on planned and foreseeable activities, existing data, and professional judgment with respect to extrapolation of that data.

II. PAST AND PRESENT ACTIVITY

The PFO has a long history of oil and gas activity; however, the majority of the 1,728 wells drilled as of June 2005 (Table M-1) were drilled within the last 15 years following discovery of a large coalbed natural gas (CBNG) resource in the Ferron Sandstone Member of the Mancos Shale. This relatively recent interest in CBNG also resulted in additional drilling in other coal-bearing formations, especially the Blackhawk Formation and the Emery Sandstone Member of the Mancos Shale. Most recently, interest has increased in the continuous and transitional gas resource in the Wasatch and Mesaverde formations and potential gas resources in some deeper formations in the northeastern part of the planning area.

The geology of the planning area, past activity, and recent production rates are described in the *Mineral Potential Report* (Booz Allen Hamilton 2002). Details of past activity, listings of conventional oil and gas fields, and cumulative production and statistics for recent drilling activity are discussed in Section 3.2 of the *Mineral Potential Report*. The occurrence potential of CBNG and conventional oil and gas is shown on Maps 3-20 and 3-21. The locations of federal oil and gas leases, mostly in the northern and western parts of the area, are shown on Map 3-23. The State of Utah oil and gas leases cover blocks of State lands southwest of the PFO. Most of the central and eastern parts of the PFO are not currently leased.

Numerous seismic surveys have been conducted throughout the planning area, primarily on areas along Highway 10, in the Book Cliffs area, in the West Tavaputs region, along Highway 6, and in the southeast region.

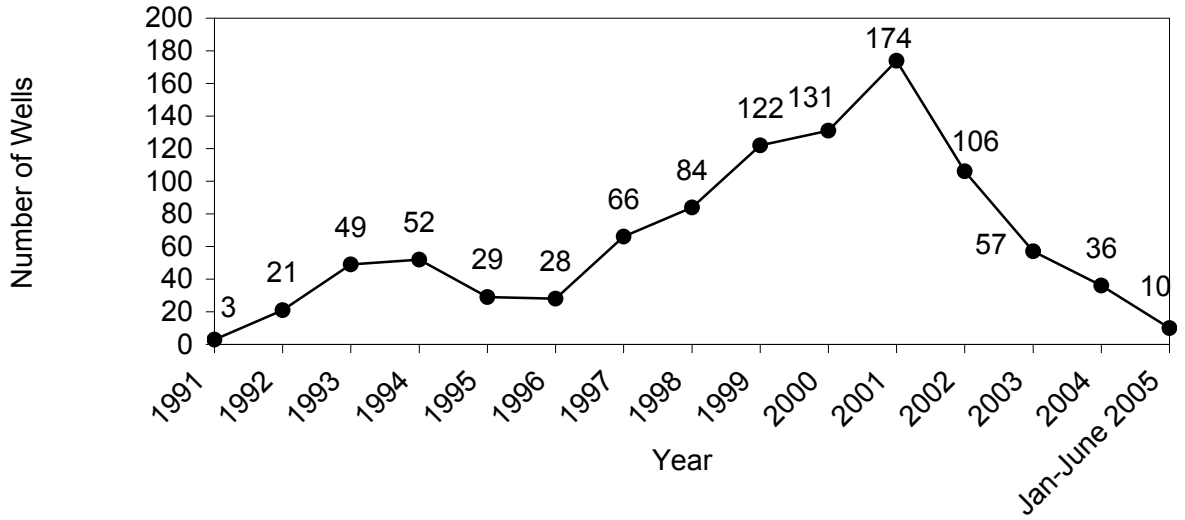
Table M-1. Summary Well Status, June 2005

Well Status	Number of Wells
Drilling	82
Producing Oil Wells	2
Producing Gas Wells	863
Shut-in Oil Wells	22
Shut-in Gas Wells	48
Service Wells (injection, disposal, monitor)	62
Shut-in Service Wells	0
Temporarily Abandoned	11
Abandoned	277
Plugged and Abandoned	361
Total	**1,728**

Source: Utah Division of Oil, Gas and Mining 2005

Drilling for oil and gas peaked in 2001 when 174 wells were spud (Figure M-1). The number dropped to 57 in 2003, 36 in 2004, and 10 through June 2005. During the period from 2000 to 2003, only 3.2 percent of the wells drilled were considered dry (Utah Division of Oil, Gas and Mining 2005). Most of the recent wells were drilled to produce CBNG from coalbeds in the Ferron Sandstone member of the Mancos Shale in the Helper, Drunkards Wash, Huntington, and Buzzard Bench areas. The Castlegate Field in the northern part of the planning area has produced CBNG from the Blackhawk Formation. The decline in drilling over the last 5 years results from the maturing of the development within the CBNG fields.

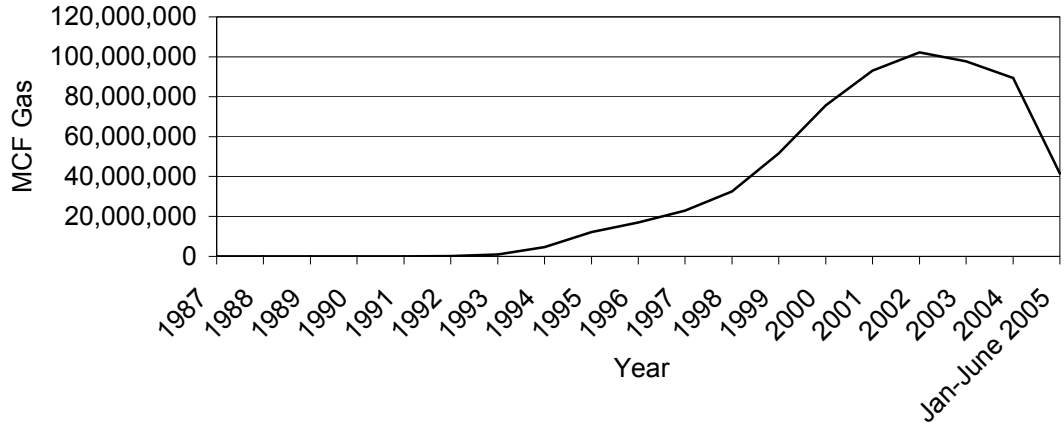
Figure M-1. Wells Drilled Per Year in the PFO



Source: Utah Division of Oil, Gas and Mining 2005.

Total CBNG production peaked in 2002 at approximately 102,000,000 thousand cubic feet (mcf) or 102 billion cubic feet (bcf). Production decreased to 97.7 bcf in 2003 and 89.3 bcf in 2004 (Figure M-2). The increase in production through 2001, seen in Figure M-2, can be attributed to new well production and the continuing dewatering process. Most of the individual wells in these fields exhibit a typical CBNG production history characterized by high rates of water production initially, followed by an increase in gas production accompanied by decreasing water production, and finally a slow decrease over time in gas production.

Figure M-2. CBNG Production per Year in the PFO



Source: Utah Division of Oil, Gas and Mining 2005.

Starting in the 1950s, gas and small amounts of oil were produced from the Green River and Wasatch formations in the Peters Point, Prickly Pear, and Stone Cabin Fields located in the northeast corner of the PFO. Cumulative gas production from this area through 2004 was approximately 7.6 bcf of gas (Utah Division of Oil, Gas and Mining 2004).

Interest is now focused on the continuous and transitional gas resources in the Wasatch and Mesaverde formations within the northeast corner of the PFO, where seismic surveys have identified drilling targets in deeper formations. Two federal exploratory units are designated in the West Tavaputs area where these formations occur and drilling interests are increasing. In the period from 2002 to 2003, 13 federal and State permits were received for drilling activities on the two units (Utah Division of Oil, Gas and Mining 2004). More recently, BLM analyzed and authorized additional drilling through the West Tavaputs Drilling Program EA. BLM anticipates many of the authorized wells will be drilled in the West Tavaputs area over the next several years. BLM has also received a proposal for additional development in this area and has published a Draft EIS on the proposed full field development. In addition to the increased drilling activity, there remains significant interest in leasing within this area as evidenced by the recent oil and gas lease sale results.

Utah and the other Rocky Mountain gas-producing States have become more integrated with the nation's natural gas system as a result of increased production and pipeline construction. In 2002, Carbon and Emery Counties ranked second and fifth respectively in gas production among Utah counties. The Kern River Pipeline crosses Utah diagonally from northeast to southwest and connects gas-producing areas in Utah and southwestern Wyoming with consumers in southern Nevada and California. This pipeline was constructed in 1991 and was expanded in 2003 to a current capacity of 1.5 bcf per day (University of Utah Bureau of Economic and Business Research 2003). A gas pipeline (Questar) from Vernal through PFO connects into the Kern River pipeline. Questar constructed a second pipeline to transport CBNG in 2001 from Price to the Kern River pipeline. In 2007, Questar extended this second pipeline from PFO toward Vernal through Nine Mile Canyon. Utah is now an overall exporter of natural gas. With the reasonably foreseeable production and expanding infrastructure, gas produced in the planning area should continue to meet increasing market demands.

III. OIL AND GAS DEVELOPMENT POTENTIAL

Areas with a high potential for the occurrence of CBNG and conventional oil and gas are shown on Maps 3-20 and 3-21. Present activity is largely confined to development of the CBNG resource in the Ferron Sandstone coals, often called the Ferron Fairway, and the continuous and transitional gas deposits in the Wasatch and Mesaverde formations in the northeastern part of the area (Tavaputs Plateau). Companies are also starting to look at conventional oil and gas plays in the northern and southeastern portions of Emery County.

Development drilling in the Ferron Fairway follows a one well per 160-acre spacing; however, future proposals could reduce this to one well per 80-acre spacing or even less. More innovative production drilling is likely to involve directional drilling and horizontal holes from existing or new wells and horizontal wells with multiple lateral legs ("herringbone pattern"). Overall, CBNG drilling has declined in the past few years and is unlikely to return to the activity levels of 1999–2001 because of field maturity. Utah Division of Oil, Gas and Mining statistics for 2004 show that 36 wells were drilled in Carbon and Emery Counties with the majority of these being CBNG wells. Development of the CBNG fields has matured to the point where lower drilling rates will likely continue in the future. Of course, the level of development is also subject to new discoveries, new drilling and recovery technologies, or major increases or decreases in natural gas prices that could result in increased or decreased drilling/development activities. Available areas for expanding activity in the Ferron Fairway are also geologically and geographically limited.

The Wasatch Plateau is in the Manti-La Sal National Forest, where a significant number of oil and gas leases currently exist (Map 3-23). Some exploratory drilling is likely in this area during the life of the plan. Coals in the Blackhawk Formation in the Wasatch Plateau appear to have low development potential (Booz Allen Hamilton 2002). As described above, coals in the Emery Sandstone Member of the Mancos Shale are the more likely exploration targets in this area. A recent draft *Mineral Potential Report*, including the Fishlake National Forest (immediately southwest of the Manti-La Sal) projects few new wells for that area. Some areas are not being developed for oil and gas because of conflicts with coal development or issues with disposal of produced water.

The northern part of the planning area includes the Book Cliffs CBNG Play (USGS 1995; Booz Allen Hamilton 2002). Development in the Castlegate Gas Field represents the only major attempt to develop this resource to date. This field contained 19 active wells (October 2003) and has produced approximately 4.4 bcf of gas through 2003 (Utah Division of Oil, Gas and Mining 2004).

The remaining area with significant development potential is the Tavaputs Plateau area in the northeast corner of the planning area. Large blocks of lands are held under existing lease rights and there are two federal exploratory units. Applications for permit to drill (APD) have been filed for wells on both federal and State of Utah lands within the units. The targeted potential resources will be continuous and transitional gas deposits in the Wasatch and Mesaverde formations and conventional gas occurrences in deeper formations. The presence of the Sunnyside Special Tar Sands Area in the Tavaputs Plateau region has prevented some oil and gas leasing in that region; however, the Energy Policy Act of 2005 opens these areas for conventional oil and gas leasing.

A Draft EIS for full field development in the West Tavaputs area was released in February 2008. Existing wells and permit applications appear to be defining an 80-acre surface spacing for at least part of this area, where approximately 807 wells on 538 well pads are projected. Operators have proposed 40-acre downhole spacing for some interim actions, but there is the probability that an even smaller spacing will be necessary to effectively and efficiently recover the resources. Topography will affect well location, and a significant number of the wells would be directionally drilled to reduce the surface impacts. The Vernal

Field Office, immediately north of this area, includes a much larger portion of the Tavaputs Plateau region and projects that 1,500 wells will be drilled during the next 10 to 20 years.

Oil production is significantly lower than gas production in Carbon and Emery Counties. During 2004, 4,661 barrels of oil were produced in Carbon and Emery Counties (Utah Division of Oil, Gas and Mining 2006), and no significant new oil discoveries and production increases are expected. Should oil or condensate be discovered, however, it will be handled in a similar way to oil under the no-action alternative. Extremely large volumes could be marketed by pipeline; but based on existing data, the more likely handling method will be through tank storage and trucking. Current production is from the Grassy Trails Field (Map 3-21) which is nearly at the end of its life. There have been no new wells drilled in this field for the last 10 to 15 years. The oil production has been augmented by production of some condensate from the gas wells in the Tavaputs area during the first few years of their production.

In summary, based on the occurrence potential and past exploration and development activities, BLM believes that future exploration and development are most likely to occur on the Wasatch (Emery/Book Cliffs CBNG Plays) and Tavaputs Plateau. Exploration of the Wasatch Plateau will most likely focus on testing the CBNG resource contained in coalbeds in the Emery Sandstone Member of the Mancos Shale (Tabet and Quick 2003). In the Tavaputs Plateau area, the targeted resources will be continuous and transitional gas deposits in the Wasatch and Mesaverde formations and conventional gas occurrences in deeper formations. The most likely source of oil is the Grassy Trails field and condensate from gas wells in the West Tavaputs area.

IV. BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION

The RFD scenario for the Price Proposed RMP/Final EIS is based on the Proposed RMP. The RFD projects the number of well pads to be constructed in the planning area during the next 20 years on all lands (BLM, USFS, State of Utah, and private). The number of wells per well pad is not limited by the RFD scenario. The RFD scenario does not establish a threshold for future federal leasing, exploration, or development activities. Rather, it is a scenario of actual and hypothetical activities that could result from implementing the proposed RMP and alternatives and their corresponding mitigation. These projected activities enable BLM to conduct an impact analysis to qualify and quantify impacts that could result from making public land available for future leasing under the constraints of the proposed RMP and alternatives. Spacing of CBNG wells is currently at one well pad per 160 acres, but future activity could reduce the spacing to one well pad per 80-acres (note: an increase in well pad density to one well pad per 80 acres, 40 acres, or other spacing does not necessarily mean twice or four times the number of well pads as multiple wells may be drilled from a single pad). An 80-acre well pad spacing is projected for parts of the Tavaputs Plateau area, but future activity could reduce this to 40-acre spacing or even less. For this RFD scenario, it is assumed that natural gas prices will remain stable between $6.00 and $9.00 per mcf or increase gradually. It is assumed that there would be additional construction to expand pipeline capacity, including looping of existing pipelines and construction of a new pipeline(s) to meet market transportation needs. Table M-2 shows projections for total new well pads for each alternative on BLM, USFS, State of Utah, and private lands over a 20-year period.

Table M-2. Estimated Number of Well Pad Locations Over 20 Years

Well Pad Location	Number of Well Pads					
	No Action Alternative	Alternative A	Alternative B	Alternative C	Alternative E	Proposed RMP
Emery/Book Cliffs Play	700	900	800	700	700	900
Tavaputs Plateau	600	700	400	300	200	700
Remaining PFO high potential area (H/D)	220	260	180	80	50	260
PFO low potential area (L/C)	20	40	20	20	0	40
Total Well Pads	**1,540**	**1,900**	**1,400**	**1,100**	**950**	**1,900**

It is anticipated that approximately 75 percent of the new well pads will be on BLM land and 25 percent on USFS, State of Utah, or private lands, with most activities for BLM-managed lands occurring in the CBNG and the West Tavaputs area.

V. Disturbance as a Result of Oil and Gas Activity

Projected Surface Disturbance

Purpose

The described impact estimates are for analysis purposes. Actual disturbances may vary based on multiple wells from a single pad, unforeseen economic conditions, new technologies, inaccuracies in the RFD scenario, and other changed conditions. Such changes will be addressed in any required site-specific analyses. The RFD scenario assists in identifying potential direct, indirect, short-term, long-term, cumulative, and residual impacts over the range of alternatives and land use allocation decisions described in the Proposed RMP/Final EIS analysis. The RFD analysis cannot be viewed as an absolute threshold for limiting activities, but rather as information necessary for making informed decisions regarding the allocation of lands that will be made available for oil and gas leasing under appropriate stipulations. Oil and gas implementation actions will undergo further reviews as necessary to ensure the existing EAs and EISs are adequate, current, and accurately reflect potential impacts for informed decisionmaking. Future analyses may result in modification/amendment of the proposed RMP decisions, goals, objectives, management actions, and the accompanying EIS impact analysis.

Assumed Disturbance Values

The calculations for acres of surface disturbance are used in the impact analysis to quantify the impacts on other resources and resource uses. The following general guidelines for roads, drill pads, pipeline, and ancillary facilities were used to determine acres of surface disturbance associated with fluid minerals exploration and development activities. The assumptions are based on existing oil and gas development across the PFO. The site-specific acres of surface disturbance vary based on factors such as topography, location, and slope. BLM will use best management practices (BMP) to reduce the impact of drilling on the environment.

Roads, Pipelines, and Powerlines

- Average initial 70 feet total width disturbance for ¾ mile per well pad (6.4 acres)
- After reclamation, average disturbance of 20 feet total width disturbance for ¾ mile per well pad (1.8 acres)

Drill Pads

- The size of pads will vary greatly depending on numerous factors and could range from 1.0 acre to more than 3.5 acres. Average initial disturbance is estimated at 1.5 acres including pits, cuts, and fills per well pad
- After reclamation, the average disturbance is 1.0 acres per well pad

Ancillary Facilities

- Average initial and long-term disturbance of 20 acres per facility (e.g., compressor stations and power substations)

Initial disturbance from roads, pipelines, powerlines, and drill pads per well pad is estimated to be 7.9 acres, decreasing to 2.8 acres per well pad after reclamation. These calculations assume that reclamation occurs when wells are in production. If drilling results in a dry hole, complete reclamation of the site would occur. After complete reclamation, for purposes of the RFD analysis and impacts from disturbance, it is assumed that the well was never drilled.

Using these average surface disturbance figures, the following future initial and long-term effects were calculated for each alternative: Impacts from past and present activity are estimated at 3,200 acres. Table M-3 and Table M-4 show the initial and long-term surface disturbance by alternative directly associated with the number of oil and gas well pads shown in Table M-2. The initial surface disturbance impacts from oil and gas activity for the Proposed RMP are 15,210 acres over 20 years. The long-term surface disturbance impacts from oil and gas activity for the Proposed RMP are 5,620 acres over 20 years.

Impacts from past and present activity are estimated at 3,200 acres (after reclamation), and when added to projected future activity, the estimate is about 18,500 acres in total disturbance. Future initial impacts will be reduced from 7.9 to 2.8 acres per well pad through reclamation, resulting in a net total disturbance of approximately 8,800 acres. Application of BMPs and revised mitigation resulting from improved technologies and adaptive management processes are expected to further reduce impacts in the future.

Table M-3. Initial Surface Disturbance from Oil and Gas Activity

Type of Activity	No Action Alternative		Alternative A		Alternative B		Alternative C		Alternative E		Proposed RMP	
	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)
Roads, Pipelines, and Powerlines	493	9,860	608	12,160	448	8,960	352	7,040	304	6,080	608	12,160
Drill Pads	116	2,310	143	2,850	105	2,100	83	1,650	71	1,425	143	2,850
Ancillary Facilities	10	200	10	200	10	200	10	200	7	140	10	200
Total Surface Disturbance	**618**	**12,366**	**761**	**15,210**	**563**	**11,260**	**445**	**8,890**	**382**	**7,645**	**761**	**15,210**

* Assumes that the well pads are evenly distributed over 20 years; however, this is not likely the case. Actual acres will vary by year.

Table M-4. Long-Term Surface Disturbance from Oil and Gas Activity

Type of Activity	No Action Alternative		Alternative A		Alternative B		Alternative C		Alternative E		Proposed RMP	
	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)	Per Year (acres)*	Over 20 Years (acres)
Roads, Pipelines, and Powerlines	139	2,772	171	3,420	126	2,520	99	1,980	86	1,710	171	3,420
Drill pads	77	1,540	95	1,900	70	1,400	55	1,100	48	950	95	1,900
Ancillary Facilities	10	200	10	200	10	200	10	200	7	140	10	200
Total Surface Disturbance	**226**	**4,512**	**276**	**5,520**	**206**	**4,120**	**164**	**3,280**	**140**	**2,800**	**276**	**5,520**

* Assumes that the well pads are evenly distributed over 20 years; however, this is not likely the case. Actual acres will vary by year.

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