APPENDIX J

NFMA ANALYSIS
EXISTING AND HISTORICAL VEGETATION

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NFMA Analysis
Existing and Historical Vegetation

This appendix presents a characterization of historical and existing vegetation conditions for a large landscape called the South George planning area. Five upland-forest indicators were used for analysis: potential vegetation, species composition, forest structure, tree density, and insect and disease susceptibility.

The vegetation information summarized in this appendix was developed using the Most Similar Neighbor (MSN) imputation process (Crookston et al. 2002, Moeur and Stage 1995). The MSN algorithm uses canonical correlation analysis to derive a similarity function, and then chooses the most similar stand as a proxy from the global set of stands by comparing detailed design attributes (local variables) and lower-resolution indicator attributes (global variables). The most similar stand is selected by using the similarity function to maintain multivariate relationships between the global variables and the local variables.

The South George planning area contains approximately 20,640 acres of National Forest System lands and was formed by combining two subwatersheds: South Fork Asotin Creek and George Creek. This appendix considers all 20,640 acres located in the planning area; acreages are rounded to nearest 10 acres.

Potential Vegetation

In the South George planning area, 34 potential vegetation types (PVTs) were identified (Table J-1). Twenty-seven of the PVTs are forest types, comprising 75% of the analysis-area acreage, and the other seven PVTs are nonforest types (25% of the planning area).

PVTs representing equivalent temperature and moisture environments have been aggregated into higher-level hierarchical units called plant association groups (PAG) and potential vegetation groups (PVG) (Powell et al. 2007). The 27 forest PVTs in the South George planning area were aggregated into 7 PAGs and 3 PVGs (table J-1) by using the information from Powell et al. (2007).

The upland forest PVGs are dry forest (24% of forested acreage), moist forest (74%), and cold forest (only 2%). This appendix uses upland forest PVGs when reporting vegetation conditions for the South George planning area. Table J-2 presents certain biophysical characteristics of the forest PVGs.

Species Composition

Plant species occur in either pure or mixed communities called cover types. Tree species occurrence in the planning area was categorized by forest cover type, a classification of existing vegetation composition (Eyre 1980). Forest cover types reflect current tree species amounts in the South George planning area.

Forest cover types are based on a predominance of tree stocking and are seldom pure – the grand fir type, for example, has a majority (50% or more) or plurality of grand fir trees but could also contain Douglas-fir and other tree species (Eyre 1980).

Table J-3 summarizes existing species composition for the South George planning area. It shows that the predominant forest cover type is grand fir (36% of the planning area has grand fir as the majority or plurality species), followed by the Douglas-fir (12%) and ponderosa pine (11%) cover types.

Note that the western larch and lodgepole pine forest cover types are relatively uncommon because each of them occupies less than 2% of the South George planning area (Table J-3).

Table J-1 Potential Vegetation Types (PVT) of the South George Planning Area

PVG	PVT and PAG	PVT Acronym	Acres	Percent of Total	Percent of Forest
Dry Upland Forest (3,672 acres; 18%)	ponderosa pine/bitterbrush/elk sedge	PIPO/PUTR/CAGE	70	< 1	1
	Douglas-fir/pinegrass	PSME/CARU	300	1	2
	Douglas-fir/common snowberry	PSME/SYAL	410	2	3
	Douglas-fir/ninebark	PSME/PHMA	1,160	6	8
	Douglas-fir/big huckleberry	PSME/VAME	300	2	2
	grand fir/elk sedge	ABGR/CAGE	450	2	3
	grand fir/pinegrass	ABGR/CARU	640	3	4
	grand fir/birchleaf spiraea	ABGR/SPBE	340	2	2
	Warm dry upland forestland PAG		3,670	18	24
Moist Upland Forest (11,503 acres; 56%)	subalpine fir/false bugbane	ABLA2/TRCA3	260	1	2
	subalpine fir/queencup beadlily	ABLA2/CLUN	90	< 1	1
	subalpine fir/big huckleberry	ABLA2/VAME	720	4	5
	subalpine fir/twinflower	ABLA2/LIBO2	590	3	4
	lodgepole pine(gf)/twinflower	PICO(ABGR)/LIBO2*	40	< 1	< 1
	lodgepole pine(gf)/big huckleberry/pinegrass	PICO(ABGR)/VAME/CARU*	50	< 1	< 1
	lodgepole pine(sf)/big huckleberry	PICO(ABLA2)/VAME*	290	1	2
	lodgepole pine(sf)/big huckleberry/pinegrass	PICO(ABLA2)/VAME/CARU*	110	1	1
	grand fir/twinflower	ABGR/LIBO2	3,680	18	24
	grand fir/queencup beadlily	ABGR/CLUN	1,760	9	11
	grand fir/big huckleberry	ABGR/VAME	2,940	14	19
	grand fir/grouse huckleberry-twinflower	ABGR/VASC-LIBO2	10	< 1	< 1
	Cool moist upland forestland PAG		10,540	51	68
	grand fir/false bugbane	ABGR/TRCA3	190	1	1
	grand fir/sword fern-ginger	ABGR/POMU-ASCA3	150	1	1
	Cool very moist upland forestland PAG		340	2	2
	grand fir/Pacific yew/queencup beadlily	ABGR/TABR/CLUN	260	1	2
	Cool wet upland forestland PAG		260	1	2
	Douglas-fir/oceanspray	PSME/HODI	70	< 1	1
	Warm moist upland forestland PAG		70	< 1	1
	grand fir/Rocky Mountain maple	ABGR/ACGL	290	1	2
	Warm very moist upland forestland PAG		290	1	2
Cold UF (1%)	subalpine fir/rusty menziesia	ABLA2/MEFE	80	< 1	1
	grand fir/grouse huckleberry	ABGR/VASC	180	1	1
	Cold moist upland forestland PAG		260	1	2
st (5,206 acres;	bluebunch wheatgrass-Sandberg's bluegrass	AGSP-POSA3	750	4	
	mountain-mahogany/ID fescue-blue. wheat.	CELE/FEID-AGSP	10	< 1	
	Idaho fescue-bluebunch wheatgrass	FEID-AGSP	3,730	18	
	Idaho fescue (alpine)	FEID (alpine)*	10	< 1	

	ninebark-common snowberry	PHMA-SYAL*	630	3
	Sandberg's bluegrass-onespike oatgrass	POSA3-DAUN	10	< 1
	western needlegrass	STOC*	70	< 1
	Nonforest PVTs		5,210	25

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Powell et al. (2007) describes how PVTs were assigned to potential vegetation groups (PVG) and plant association groups (PAG).
* These PVTs are plant community types or plant communities; all others are plant associations.

Table J-2 Biophysical characteristics for upland forest potential vegetation groups (PVG)

PVG	Area (Acres)	Distur-bances	Fire Regime	Patch Size	Elevation (Feet)	Slope (Percent)	Dominant Aspects
Dry Upland Forest	3,670	Fire Insects Harvest	Frequent Surface	1-3,000	4,500 (3410-5560)	40 (10-60)	Southeast South Southwest
Moist Upland Forest	11,500	Insects Fire Diseases	Infrequent Mixed	1-10,000	4,960 (3630-5970)	30 (0-60)	Southeast South Southwest
Cold Upland Forest	260	Wind Insects Fire	Replacem ent	1-5,000	Elevation, slope, and aspect were not summarized for the Cold PVG because it has too few acres to analyze.		

Sources/Notes: Area, elevation, slope, and aspects were derived from the South George vegetation database (NFS lands only). Patch size was taken from Johnson (1993). For elevation and slope, values are presented in this format: average (minimum-maximum). Fire regime names correspond to Schmidt et al. (2002). Disturbances and fire regimes were supplied by the author.

Table J-3 Existing species composition (cover types) for the South George planning area

Code	Cover Type Description	Acres	Pct. of Total	Pct. of Forested
Nonforest	Nonforest cover types on lands with a nonforest site potential	5,210	25	
Herb-shrub	Nonforest cover types on lands with a forest site potential	210	1	1
PIPO	Forest with ponderosa pine as the majority species	1,740	8	11
mix-PIPO	Mixed forest with ponderosa pine as the plurality species	510	3	3
Ponderosa pine	Forest with ponderosa pine as the majority or plurality species	2,250	11	15
PSME	Forest with Douglas-fir as the majority species	2,120	10	14
mix-PSME	Mixed forest with Douglas-fir as the plurality species	360	2	2
Douglas-fir	Forest with Douglas-fir as the majority or plurality species	2,480	12	16
LAOC	Forest with western larch as the majority species	310	2	2
mix-LAOC	Mixed forest with western larch as the plurality species	0	0	0
Western larch	Forest with western larch as the majority or plurality species	310	2	2
PICO	Forest with lodgepole pine as the majority species	80	< 1	1
mix-PICO	Mixed forest with lodgepole pine as the plurality species	220	1	1
Lodgepole pine	Forest with lodgepole pine as the majority or plurality species	300	2	2
ABGR	Forest with grand fir as the majority species	5,970	29	39
mix-ABGR	Mixed forest with grand fir as the plurality species	1,510	7	10
Grand fir	Forest with grand fir as the majority or plurality species	7,480	36	49
PIEN	Forest with Engelmann spruce as the majority species	350	2	2

mix-PIEN	Mixed forest with Engelmann spruce as the plurality species	1,550	8	10
Engelmann spruce	Forest with Engelmann spruce as the majority or plurality species	1,900	9	12
ABLA2	Forest with subalpine fir as the majority species	240	1	2
mix-ABLA2	Mixed forest with subalpine fir as the plurality species	280	1	2
Subalpine fir	Forest with subalpine fir as the majority or plurality species	520	3	3

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Forest cover types where one tree species comprises a majority of the composition (50% or more) are named for the species (Eyre 1980). For a cover type where no single species predominates, it is named for the plurality species preceded by "mix" to denote a mixed-species composition.

About 25% of the South George planning area supports nonforest vegetation (Table J-1), much of which consists of dry meadows and bunchgrass communities dominated by Idaho fescue or bluebunch wheatgrass. In the context of the Umatilla National Forest, the South George planning area contains a higher proportion of nonforest vegetation than the Forest as a whole (Christensen et al. 2007).

HRV Analysis for Species Composition

An historical range of variability (HRV) analysis was used to evaluate species composition for the South George planning area; HRV results are presented in Table J-4. It summarizes the current amount of each forest cover type by potential vegetation group (PVG), and the historical range is also shown.

The information presented in Table J-4 suggests that the dry upland forest PVG currently supports too much of the Douglas-fir and grand fir forest cover types, and too little of the ponderosa pine cover type (Table J-4a); the moist forest PVG (Table J-4b) supports too much of the grand fir and spruce-fir forest cover types, and too little of the lodgepole pine, western larch, and Douglas-fir cover types.

Even though percents and acreages are presented for the cold forest PVG (Table J-4c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-4a HRV analysis for species composition on the dry upland forest PVG

	Historical Range		Current Amount		
Cover Type	**Percent**	**Acres**	**Percent**	**Acres**	**HRV Interpretation**
Grass-forb	0-5	0-180	0	0	At low end of historical range
Shrub	0-5	0-180	0	0	At low end of historical range
Western juniper	0-5	0-180	0	0	At low end of historical range
Ponderosa pine	50-90	1840-3310	32	1160	Below the historical range
Douglas-fir	5-20	180-730	45	1670	Well above the historical range
Western larch	0-10	0-370	0	0	At low end of historical range
Broadleaved trees	0-5	0-180	0	0	At low end of historical range
Lodgepole pine	0-5	0-180	0	0	At low end of historical range
Grand fir	1-10	40-370	23	850	Well above the historical range

Table J-4b HRV analysis for species composition on the moist upland forest PVG

Cover Type	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Grass-forb	0-5	0-580	2	210	Within the historical range
Shrub	0-5	0-580	0	0	At low end of historical range
Ponderosa pine	5-15	580-1730	9	980	Within the historical range
Douglas-fir	15-30	1730-3450	7	810	Below the historical range
Western larch	10-30	1150-3450	3	310	Below the historical range
Broadleaved trees	1-10	120-1150	0	0	Below the historical range
Lodgepole pine	10-25	1150-2880	3	300	Below the historical range
Western white pine	0-5	0-580	0	0	At low end of historical range
Grand fir	15-30	1730-3450	58	6630	Well above historical range
Spruce-fir	1-15	120-1730	20	2260	Above the historical range

Table J-4c HRV analysis for species composition on the cold upland forest PVG

Cover Type	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Grass-forb	0-5	0-10	0	0	This PVG contains too few acres (only 260) for an HRV analysis, which should not be completed for PVGs having less than 1,000 acres in a planning area. It is also not appropriate to add the cold PVG acreage to another PVG for analysis purposes because each PVG represents a unique biophysical environment.
Shrub	0-15	0-40	0	0	
Ponderosa pine	0-5	0-10	42	110	
Douglas-fir	5-15	10-40	0	0	
Western larch	5-15	10-40	0	0	
Broadleaved trees	0-5	0-10	0	0	
Lodgepole pine	25-45	60-120	0	0	
Grand fir	5-15	10-40	0	0	
Whitebark pine	0-10	0-30	0	0	
Spruce-fir	20-40	50-100	58	150	

Sources/Notes for tables A4a to A4c: Current amounts are summarized from the South George vegetation database (NFS lands only). Historical ranges were adapted by the author of this specialist report from Morgan and Parsons (2001); they were based on multiple 1200-year simulations representing landscapes in a dynamic equilibrium with their disturbance regimes.

Historical Species Composition

Two historical maps supplied species composition reference conditions for the South George planning area (Tables A5 and A6).

The earliest historical mapping was based on the original public land survey completed for the Umatilla National Forest between 1879 and 1887 (table J-5). It shows that almost half of the South George planning area was dominated by deciduous conifer forest in the late 1800s (western larch; 45% of the area), followed by mixed-conifer forest with a predominance of either Douglas-fir or grand fir (38% of the area for three mixed-conifer types combined) and open ponderosa pine savanna (15% of the area).

Table J-5 Historical species composition for the South George planning area in the 1880s era

Ecological System Name (from NatureServe 2003)	Acres	Percent
No Trees (section corners & quarter corners without any bearing trees)	50	< 1
Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland (riparian forest)	260	1
Rocky Mountain Lower Montane Riparian Woodland & Shrubland (riparian forest)	2	< 1
Rocky Mountain Ponderosa Pine Woodland (open ponderosa pine savanna)	3160	15
Northern Rocky Mountain Montane Mixed Conifer Forest (mixed grand fir forest)	2760	13
Rocky Mountain Montane Mesic Mixed Conifer Forest & Woodland (mixed grand fir forest)	260	1
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest & Woodland (mixed Douglas-fir forest)	4870	24
Northern Rocky Mountain Western Larch Woodland & Forests (western larch forest)	9290	45
Rocky Mountain Subalpine Mesic Spruce-Fir Forest & Woodland (spruce-fir forest)	10	< 1

Sources/Notes: Summarized from General Land Office survey notes collected at section corners and quarter-section corners between 1879 and 1887. Bearing-tree characteristics (species, diameter, and distance from corner) were entered into a database and then used to spatially interpolate species composition information across the Umatilla National Forest by using kriging and co-kriging analytical procedures (Powell 2008).

The second historical map depicts composition conditions as they existed in the mid 1950s (Spada et al. 1957), about 50 years before present (Table J-6 and figure A1). It shows that ponderosa pine forest was the predominant cover type, occupying more than 40 percent of the planning area acreage, followed by nonforest types (19%), grand fir forest (15%), and Douglas-fir forest (12%).

Table J-6 Historical species composition for the South George planning area in 1957

Mapped Type	Inferred Vegetation Conditions	Acres	Percent of Total	Percent of Forested
Douglas-fir	Douglas-fir is the majority or plurality species	2,470	12	15
Grand fir	Grand fir is the majority or plurality species	3,180	15	19
Lodgepole-Larch	Lodgepole pine and western larch are the plurality species	1,980	10	12
Ponderosa pine	Ponderosa pine is the majority or plurality species	8,360	41	50
Spruce-fir	Engelmann spruce & subalpine fir are the plurality species	800	4	5
Nonforest	Nonforest cover types	3,840	19	

Sources/Notes: Summarized from "Forest type map of southeast Washington" (Spada et al. 1957). The author of this specialist report interpreted the 1957 map legend to derive the "inferred vegetation conditions."

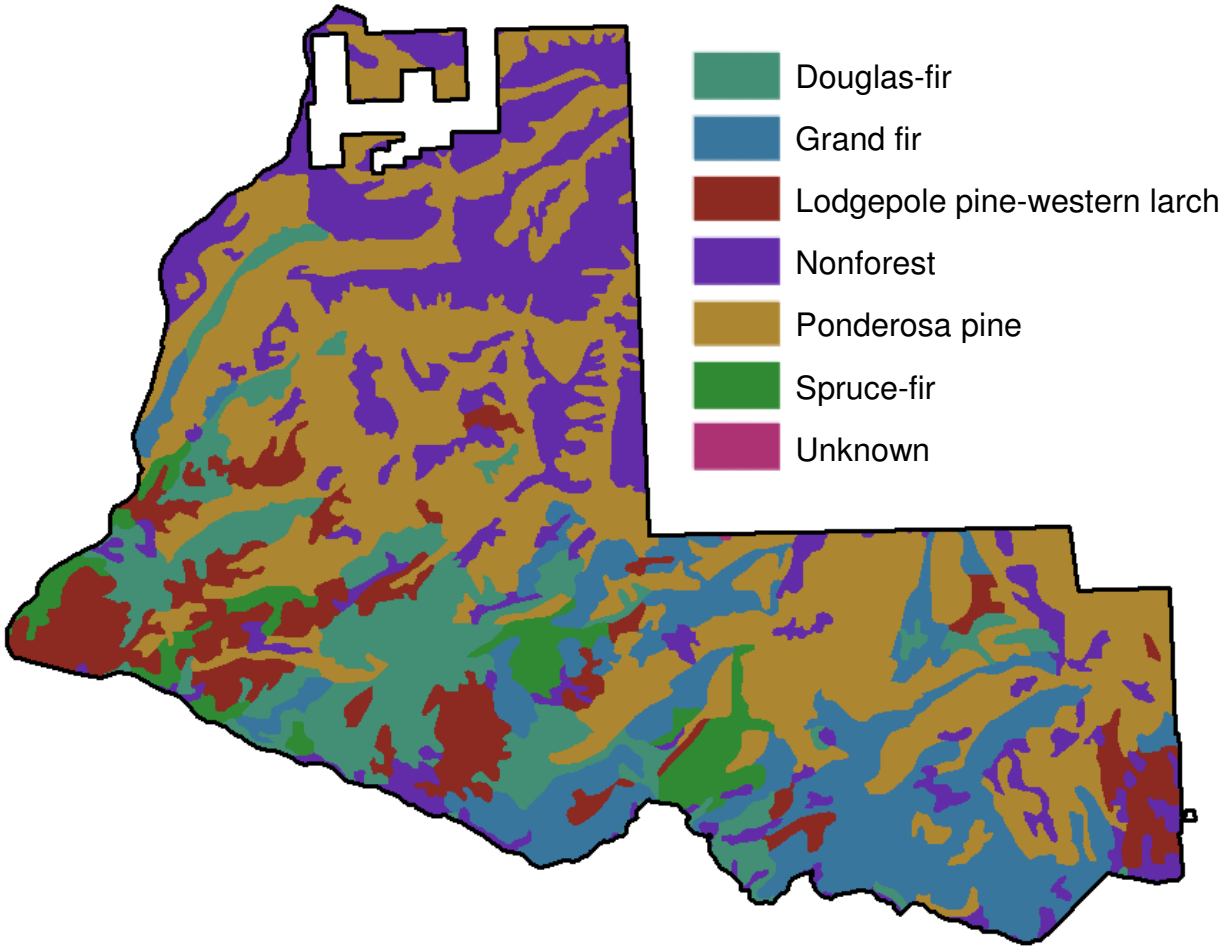

Figure A1 – Species composition reference conditions as they existed about 1957 (derived from a forest type map for southeast Washington, as prepared by Spada et al. 1957 – see sources and notes for Table J-6).

Forest Structure

Oliver and Larson (1996) developed a forest structure classification system incorporating four structural stages. Oliver and Larson's (1996) system works well for conifer forests west of the Cascade Mountains, but it does not adequately characterize the diverse structural conditions of the interior Pacific Northwest. Therefore, the Oliver and Larson (1996) system was expanded to eight classes to include a wider spectrum of structural variation (O'Hara et al. 1996).

Table J-7 uses the 8-class system developed by O'Hara et al. (1996) to summarize the acreages and percentages of forest structural stages for the South George planning area. It shows that the predominant structural stage is understory reinitiation (UR), followed by old forest single stratum (OFSS), stem exclusion open canopy (SEOC), and old forest multi strata (OFMS).

Table J-7 shows that stand initiation (SI) and young forest multi strata (YFMS) are relatively uncommon structural stages – each of them occupies less than 5 percent of the South George planning area.

Table J-7 Existing forest structural stages for the South George planning area

Code	Forest Structural Stage Name	Acres	Percent of Total	Percent of Forested
BG	Bare Ground	0	0	0
SI	Stand Initiation	570	3	4
SEOC	Stem Exclusion Open Canopy	2,200	11	14
SECC	Stem Exclusion Closed Canopy	1,540	8	10
UR	Understory Reinitiation	4,610	22	30
YFMS	Young Forest Multi Strata	330	2	2
OFMS	Old Forest Multi Strata	1,720	8	11
OFSS	Old Forest Single Stratum	4,460	22	29
NF	Nonforest: grassland and shrubland	5,210	25	

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Forest structural stages are described in O'Hara et al. (1996). Structural stage, a derived field in the database, was calculated using queries from Hessburg et al. (1999a).

HRV Analysis for Forest Structural Stages

An historical range of variability (HRV) analysis was used to evaluate forest structure for the South George planning area; HRV results are provided in Table J-8. It summarizes the current amount of each forest structural stage by potential vegetation group (PVG), and the historical range is also shown.

For the dry forest PVG (Table J-8a), analysis results show that two structural stages are below HRV (stand initiation and young forest multi strata), and that one stage is above HRV (understory reinitiation). The other four stages (both forms of stem exclusion and both forms of old forest) are within their historical ranges.

For the moist forest PVG (Table J-8b), two stages are below HRV (young forest multi strata and old forest multi strata), two stages are above HRV (stem exclusion open canopy and old forest single stratum), and the other three stages are within HRV (stand initiation, stem exclusion closed canopy, and understory reinitiation).

Even though percents and acreages are presented for the cold forest PVG (Table J-8c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

The wildlife standard from the Eastside Screens (Forest Plan amendment #11; USDA Forest Service 1995) has two possible scenarios to follow as based on HRV results for late-old structural stages (LOS), and it defines LOS to be the old forest multi strata and old forest single stratum structural stages.

The wildlife standard directs that one of two scenarios is to be used:

1. Scenario A is to be used whenever either one of the LOS stages is below HRV. If both LOS stages occur within a single PVG and one is within or above HRV and one below, scenario A is to be used.
2. Scenario B is only to be used when both LOS stages for a particular PVG are within or above HRV.

For the dry and moist PVGs, results of the Eastside Screens wildlife standard are presented in the Screens Interpretation columns of Tables A8a and A8b.

Table J-8a HRV analysis for forest structural stages on the dry upland forest PVG

Structural Stage	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation	Screens Interpretation
Stand initiation	5-15	180-550	4	130	Below HRV	
Stem exclusion OC	5-20	180-730	8	280	Within HRV	
Stem exclusion CC	1-10	40-370	7	260	Within HRV	
Understory reinitiation	1-10	40-370	24	880	Above HRV	
Young forest MS	5-25	180-920	1	20	Below HRV	
Old forest MS	5-20	180-730	17	640	Within HRV	**Scenario B**
Old forest SS	15-55	550-2020	40	1450	Within HRV	

Table J-8b HRV analysis for forest structural stages on the moist upland forest PVG

Structural Stage	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation	Screens Interpretation
Stand initiation	1-10	120-1150	3	400	Within HRV	
Stem exclusion OC	0-5	0-580	17	1910	Above HRV	
Stem exclusion CC	5-25	580-2880	11	1290	Within HRV	
Understory reinitiation	5-25	580-2880	30	3510	Within HRV	
Young forest MS	40-60	4600-6900	3	310	Below HRV	
Old forest MS	10-30	1150-3450	9	1080	Below HRV	**Scenario A**
Old forest SS	0-5	0-580	26	3010	Above HRV	

Table J-8c HRV analysis for forest structural stages on the cold upland forest PVG

Structural Stage	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation	Screens Interpretation
Stand initiation	1-20	3-50	16	40	This PVG contains too few acres (only 260) for an HRV analysis, which should not be completed for PVGs having less than 1,000 acres in a planning area. It is also not appropriate to add the cold PVG acreage to another PVG for analysis purposes because each PVG represents a unique biophysical environment.	
Stem exclusion OC	0-5	0-10	0	0		
Stem exclusion CC	5-20	10-50	0	0		
Understory reinitiation	5-25	10-60	84	220		
Young forest MS	10-40	30-100	0	0		
Old forest MS	10-40	30-100	0	0		
Old forest SS	0-5	0-10	0	0		

Sources/Notes for Tables A8a to A8c: Current amounts are summarized from the South George vegetation database (NFS lands only). OC refers to open canopy and CC to closed canopy; MS refers to multi strata and SS to single stratum. Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Historical percentages (H%) were derived from Hall (1993), Johnson (1993), and USDA Forest Service (1995), as summarized in Blackwood (1998). Forest structural stages are enumerated in Table J-7. For the purposes of an HRV analysis, the bare ground structural stage is combined with the stand initiation stage.

Historical Forest Structural Stages

An historical map depicts forest structural stages as they existed in the mid 1950s (Spada et al. 1957), about 50 years before present (Table J-9 and figure A2). It shows that in the mid 1950s, about 60 percent of the South George planning area was dominated by old forest structural stages (the OFMS and OFSS stages; 60.1% of the acreage), followed by dense stands of relatively small-diameter trees (SECC; 15.9% of the acreage) and multi-layer stands (UR; 4.5% of the area).

Table J-9 Historical forest structural stages for the South George planning area

Code	Forest Structural Stage Name	Acres	Percent of Total	Percent of Forested
BG	Bare Ground	0	0	0
SI	Stand Initiation	100	1	1
SEOC	Stem Exclusion Open Canopy	100	1	1
SECC	Stem Exclusion Closed Canopy	3,280	16	20
UR	Understory Reinitiation	920	5	6
YFMS	Young Forest Multi Strata	0	0	0
OFMS	Old Forest Multi Strata	3,120	15	19
OFSS	Old Forest Single Stratum	9,280	45	55
NF	Nonforest: grassland and shrubland	3,840	19	

Sources/Notes: Summarized from "Forest type map of southeast Washington" (Spada et al. 1957). Forest structural stage codes and names are the same as those for Table J-7.

Existing Forest Canopy Layering

One aspect of forest structure examines how the leaf area of a forest stand is arranged in a vertical dimension. Information about vertical forest structure indicates whether a stand has a single canopy layer, where canopy biomass is concentrated in a discrete band well above the ground, or if it has multiple layers resulting in continuous foliage from the ground surface up to the top of the tree canopy.

After fires became larger and more severe in the mid 1990s, there was heightened concern about canopy layering because understory layers function as ladder fuel – like a ladder, low canopy layers are able to lift a surface fire up into the tree crowns, allowing it to spread rapidly as a crown fire. And because crown fires often consume most of a forest's canopy foliage, they typically cause high amounts of tree mortality.

Table J-10 summarizes the acreages and percentages of forest canopy layering for the South George planning area. It shows that the predominant canopy layering condition is single layer (61% of forested acreage), with the balance consisting of multiple layers (39%).

Table J-10 Existing forest canopy layering for the South George area

Forest Canopy Layering Description	Acres	Percent of Total	Percent of Forested
Single layer	9,460	46	61
Multiple layers	5,970	29	39
None (nonforest polygons)	5,210	25	

Sources/Notes: Summarized from the South George vegetation database (NFS lands only).

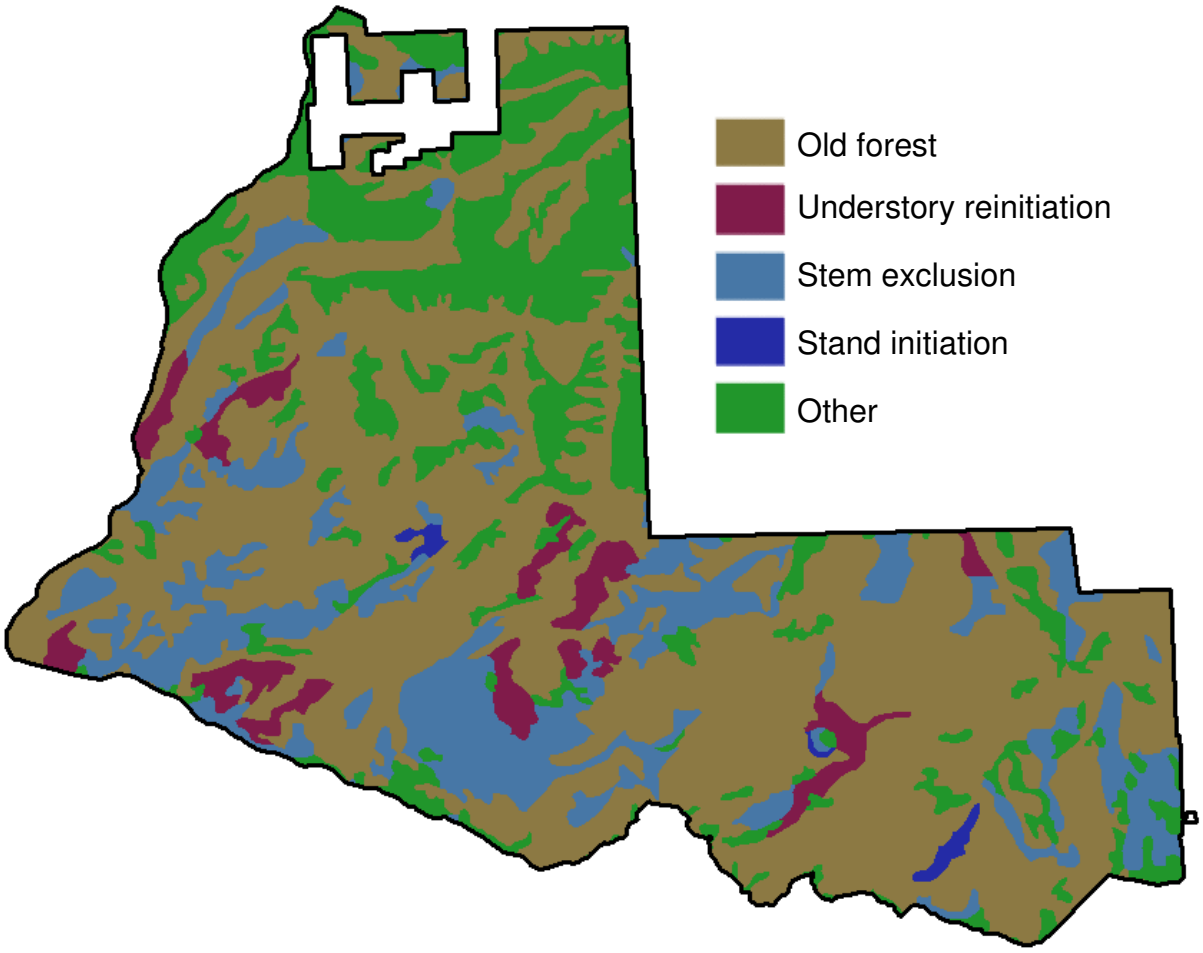

Figure A2 – Forest structure reference conditions as they existed about 1957 (derived from a forest type map for southeast Washington, as prepared by Spada et al. 1957 – see sources and notes for table J-9). Note that the two old forest stages, and the two stem exclusion stages, as reported in Table J-9, were combined for this map depiction.

HRV Analysis for Forest Canopy Layering

How much single-layer and multi-layer structure would have occurred historically on upland forest sites? Table J-11 presents an historical range of variability (HRV) analysis for canopy layering on upland-forest PVGs (Powell 2003).

Table J-11a shows that for the dry forest PVG, both the single-layer and multiple-layers canopy conditions are within their historical ranges of variability. For the moist forest PVG (Table J-11b), both the single-layer and multiple-layers canopy conditions are outside their historical ranges of variability.

Even though percents and acreages are presented for the cold forest PVG (Table J-11c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-11a HRV analysis for forest canopy layering on the dry upland forest PVG

Canopy Layering	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation
Single layer	25-100	920-3670	57	2090	Within the historical range
Multiple layers	10-55	370-2020	43	1580	Within the historical range

Table J-11b HRV analysis for forest canopy layering on the moist upland forest PVG

Canopy Layering	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation
Single layer	6-45	690-5180	64	7330	Above the historical range
Multiple layers	55-100	6330-11500	36	4180	Below the historical range

Table J-11c HRV analysis for forest canopy layering on the cold upland forest PVG

Canopy Layering	Historical Range Percent	Historical Range Acres	Current Amount Percent	Current Amount Acres	HRV Interpretation
Single layer	6-50	20-130	16	40	No interpretation because this PVG contains too few acres.
Multiple layers	25-100	60-260	84	220	

Sources/Notes for Tables A11a to A11c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Historical ranges were derived from Table J-8: the single-layer condition is a combination of SI, SEOC, SECC, and OFSS; the multiple-layers condition is a combination of UR, YFMS, and OFMS.

Tree Density

Suggested stocking guidelines (Cochran et al. 1994, Powell 1999) were used to analyze existing tree density levels for the South George planning area. By using the stocking guidelines in conjunction with PVGs, it was possible to estimate how much forest acreage is currently overstocked (Table J-12); the tree density analysis protocol is described in Powell (2009c).

Results of the tree density analysis are summarized in Table J-12; it shows that the South George area has a relatively well-balanced distribution of tree density, with about a third of the forested acreage occurring in each of the three density categories (low, moderate, high).

Table J-12 Existing tree density for the South George area

Tree Density Category	Acres	Percent of Total	Percent of Forested
Low	5,250	25	34
Moderate	5,630	27	37
High	4,570	22	30
None (nonforest polygons)	5,210	25	

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Queries for assigning polygons to the tree density categories are provided in Powell (2009c).

HRV Analysis for Tree Density

An historical range of variability (HRV) analysis was used to evaluate tree density for the South George planning area; results are provided in Table J-13. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Table J-13a shows that the dry forest PVG has more acreage supporting high-density forest than would be expected, and less acreage supporting low-density forest. For the moist forest PVG (Table J-13b), all three of the tree density classes are within their historical ranges of variability.

Even though percents and acreages are presented for the cold forest PVG (Table J-13c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-13a HRV analysis for tree density on the dry upland forest PVG

	Historical Range		Current Amount		
Tree Density Class	Percent	Acres	Percent	Acres	HRV Interpretation
Low (<45% CC)	40-85	1470-3120	25	920	Below the historical range
Moderate (45-55%)	15-30	550-1100	28	1020	Within the historical range
High (>55% CC)	5-15	180-550	47	1730	Well above the historical range

Table J-13b HRV analysis for tree density on the moist upland forest PVG

	Historical Range		Current Amount		
Tree Density Class	Percent	Acres	Percent	Acres	HRV Interpretation
Low (<65% CC)	20-40	2300-4600	36	4170	Within the historical range
Moderate (65-75%)	25-60	2880-6900	40	4590	Within the historical range
High (>75% CC)	15-30	1730-3450	24	2750	Within the historical range

Table J-13c HRV analysis for tree density on the cold upland forest PVG

	Historical Range		Current Amount		
Tree Density Class	Percent	Acres	Percent	Acres	HRV Interpretation
Low (<55% CC)	15-30	40-80	61	160	No interpretation because this PVG contains too few acres.
Moderate (55-65%)	20-40	50-100	10	30	
High (>65% CC)	25-60	60-160	29	70	

Sources/Notes for Tables A13a to A13c: Current amounts are derived from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Historical ranges were taken from Schmitt and Powell (2008).

Existing Forest Canopy Biomass

One result of severe wildfire seasons in the late 1990s and early 2000s is that land management activities (mechanical thinnings and prescribed fire) are being considered for millions of acres considered to be at-risk for uncharacteristic wildfire behavior and undesirable fire effects (GAO 1999, Gorte 1995, Laverty and Williams 2000).

At-risk areas support uncharacteristic levels of forest canopy biomass (canopy bulk density), rendering them vulnerable to crown fire spread (Graham et al. 1999, 2004). Research shows that high canopy

biomass causes forest stands to be more vulnerable to crown fire initiation at any age, and it also extends the duration of a stand's exposure to crown fire hazard by 20 to 30 years (Keyes and O'Hara 2002).

Forest canopy biomass was estimated for the South George planning area by relating stand-level thresholds of canopy bulk density to their corresponding stocking levels (Agee 1996, Keyes and O'Hara 2002); the forest canopy biomass analysis protocol is described in Powell (2005).

Results of the canopy biomass analysis are summarized in Table J-14. It shows that almost 88% of the upland forest acreage in the South George planning area has sufficient forest canopy biomass to sustain a crown fire (in Table J-14, 88% is a total for the moderate and high categories combined).

In the context of the Umatilla National Forest, the South George planning area contains a greater proportion of high forest canopy biomass than the Forest as a whole (Christensen et al. 2007).

Table J-14 Existing forest canopy biomass for the South George area

Canopy Biomass Category	Acres	Percent of Total	Percent of Forested
Low (≤ .05 kg/m^3)	2,130	10	14
Moderate (.06-.09 kg/m^3)	3,730	18	24
High (≥ .10 kg/m^3)	9,570	46	62
None (nonforest polygons)	5,210	25	

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Numerical values shown in parentheses for each category are canopy bulk density in kg/m^3 of canopy volume. Powell (2005) provides the basis for assigning polygons to canopy biomass categories.

HRV Analysis for Forest Canopy Biomass

An historical range of variability (HRV) analysis was used to evaluate forest canopy biomass for the South George planning area; HRV results are provided in Table A15. It summarizes the current amount of each canopy biomass category by potential vegetation group (PVG), and the historical range is also shown.

Table J-15a and A15b show that both the dry and moist upland forest PVGs have more acreage supporting high canopy biomass than would be expected, and less acreage supporting low canopy biomass. Moderate amounts of forest canopy biomass are either within the historical range (dry PVG; Table J-15a) or below the historical range (moist PVG; Table J-15b).

Even though percents and acreages are presented for the cold forest PVG (Table J-15c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-15a HRV analysis for forest canopy biomass on the dry upland forest PVG

	Historical Range		Current Amount		
Canopy Biomass Class	Percent	Acres	Percent	Acres	HRV Interpretation
Low (≤ .05 kg/m^3)	60-90	2200-3300	15	530	Well below the historical range
Moderate (.06-.09 kg/m^3)	20-60	730-2200	42	1540	Within the historical range
High (≥ .10 kg/m^3)	10-20	370-730	44	1600	Well above the historical range

Table J-15b HRV analysis for forest canopy biomass on the moist upland forest PVG

Canopy Biomass Class	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low (≤ .05 kg/m^3)	20-50	2300-5750	13	1490	Below the historical range
Moderate (.06-.09 kg/m^3)	50-70	5750-8050	18	2110	Well below the historical range
High (≥ .10 kg/m^3)	20-50	2300-5750	69	7900	Above the historical range

Table J-15c HRV analysis for forest canopy biomass on the cold upland forest PVG

Canopy Biomass Class	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low (≤ .05 kg/m^3)	10-20	30-50	42	110	No interpretation because this PVG contains too few acres.
Moderate (.06-.09 kg/m^3)	20-60	50-150	30	80	
High (≥ .10 kg/m^3)	60-90	150-230	29	70	

Sources/Notes for Tables A15a to A15c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Historical ranges for canopy biomass classes were derived by the author of this specialist report from Agee (1998).

Insects and Diseases

Disturbance processes influence forest composition, structure and density (Perera et al. 2004). Although many different disturbance processes have influenced vegetation conditions in the South George area to varying degrees in the recent past, forest insects have been particularly important as disturbance agents (see fig. 2-3).

Information provided by the Pacific Northwest Region's aerial survey program was used to assess recent impacts from forest insects; annual insect activity was recorded on a "sketch map" (fig. A3). Aerial detection sketch maps for a 19-year period (1990-2008) were used to summarize the spatial extent of recent activity for three groups of forest insects: defoliators, pine beetles, and mixed-conifer beetles.

Acreage affected by forest insects in the South George planning area is summarized in figure A4; the annual areal extent of insect occurrence in the planning area is portrayed on maps in appendix B.

Figure A4 shows that pine beetles (this category includes mountain pine beetle in either lodgepole pine or ponderosa pine, *Ips* beetle in pine, and western pine beetle) had relatively little impact in the South George planning area since 1990, with the most acreage affected being 680 acres in 2005.

Figure A4 shows that mixed-conifer beetles (this category includes Douglas-fir beetle, fir engraver, spruce beetle, and western balsam bark beetle) had considerable impact in the planning area since 1990, with substantial acreage affected in 1990-1991, 2003, and 2007-2008. A quarter or more of the forested portion of the South George planning area was affected by mixed-conifer beetles in 1990, 1991, and 2003.

Figure A4 shows that defoliating insects (this category includes Douglas-fir tussock moth and western spruce budworm) had very little impact in the South George planning area since 1990. But in the late 1940s and early 1950s, and then again in the 1980s, western spruce budworm was defoliating substantial acreages of mixed-conifer forest throughout the Blue Mountains, and we can expect another widespread outbreak of this forest insect in the near future.

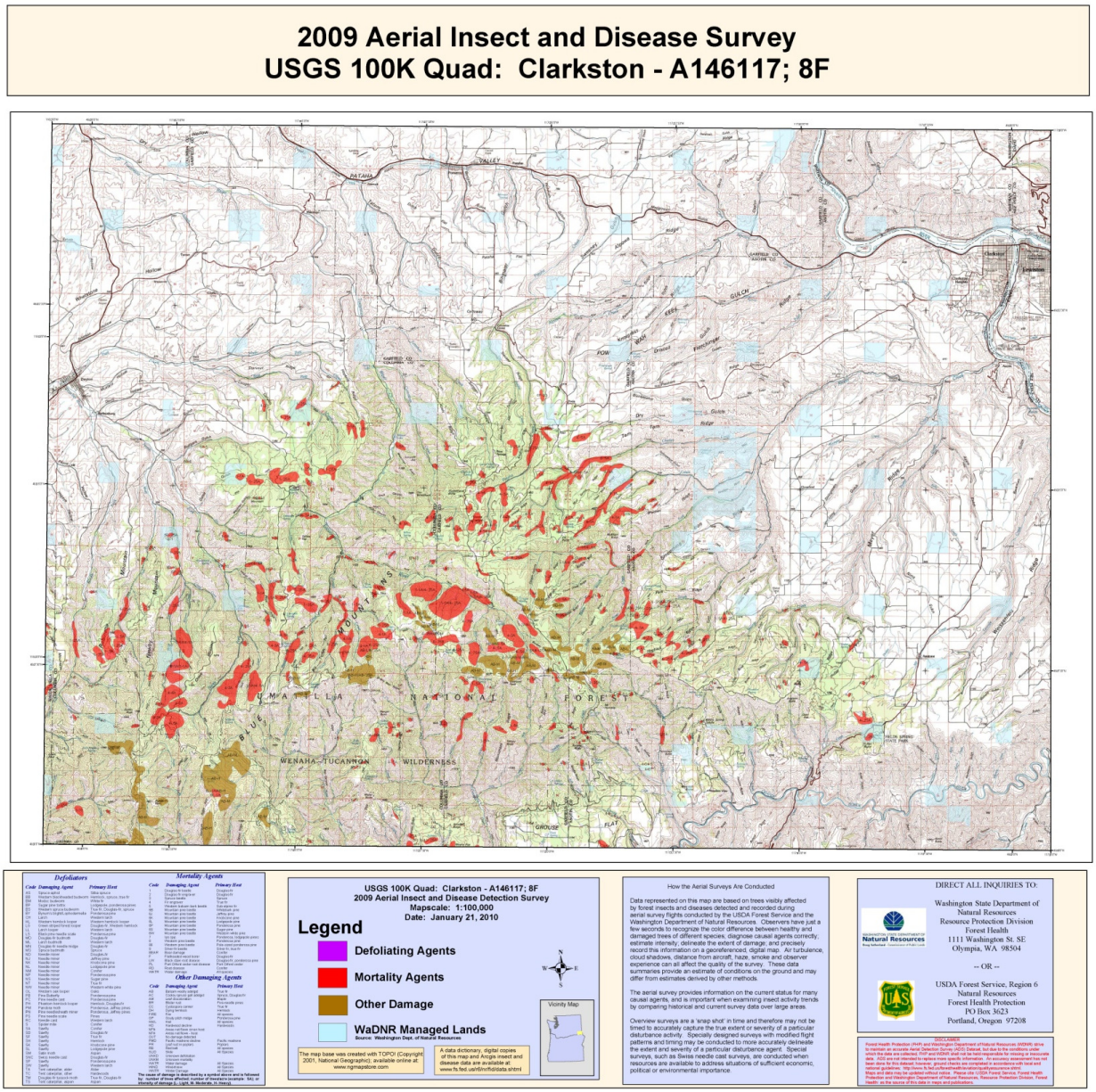

Figure A3 – Example of a sketch map prepared during aerial detection surveys to document the insects and other damaging agents affecting an area, and to estimate the magnitude of their impact. This example is for the Clarkston 100K USGS quadrangle map and it depicts the spatial distribution of damaging agents (the red polygons) recorded during the 2009 aerial survey. This quadrangle was selected as an example because it includes the South George planning area. Although this sample has been reduced too much from its original size to allow the polygon labels to be readable, each of the red areas contains a label denoting the causal agent and a modifier providing an estimate of damage severity. A polygon label of 4-1A, for example, means that the primary damaging agent within the polygon was fir engraver (code 4 pertains to fir engraver), and that the magnitude or rate of tree damage was 1 tree per acre (the 1A portion of the label). This example of polygon labeling also demonstrates that the size of a polygon is related exclusively to the spatial distribution of the causal agent and has no bearing on the severity of damage – a large polygon can encompass much acreage and yet the damage levels across the area can be relatively light (such as 1 tree per acre).

Note: the maps in appendix B characterizing recent insect activity for the South George planning area were prepared using information collected from aerial detection surveys and published on maps such as the one shown here.

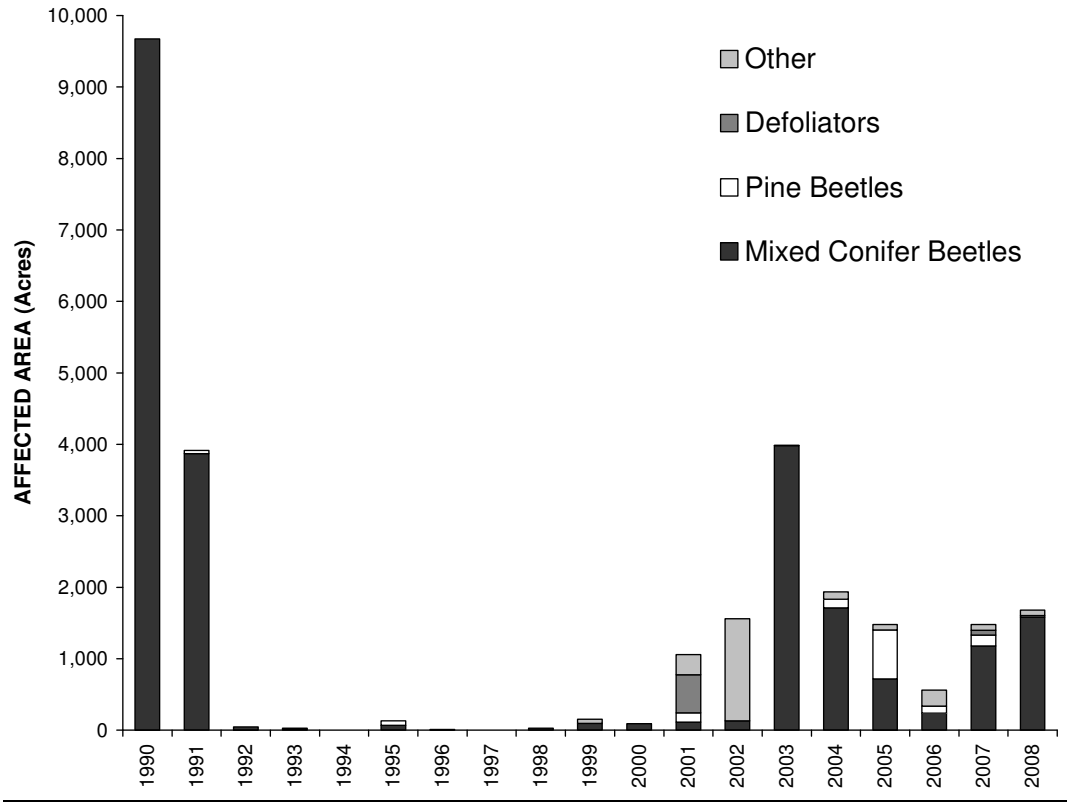

Figure A4 – Area affected by forest insects in the South George planning area. Affected areas (acres) were derived from aerial detection surveys completed by the Pacific Northwest Region of the Forest Service. Note that area figures include National Forest System (NFS) lands only. "Defoliators" includes Douglas-fir tussock moth and western spruce budworm; "pine beetles" includes mountain pine beetle in either lodgepole pine or ponderosa pine, Ips beetle in pine, and western pine beetle; and "mixed-conifer beetles" includes Douglas-fir beetle and fir engraver. "Other" includes balsam woolly adelgid, wood borers, needle diseases, and other miscellaneous agents.

Existing Insect and Disease Susceptibility

Susceptibility is defined as a set of conditions that make a forest stand vulnerable to substantial injury by insects or diseases. Susceptibility assessments do not predict when insects and diseases might reach damaging levels; rather, they indicate whether stand conditions are conducive to declining forest health and increasing levels of tree mortality caused by insect and disease organisms.

For this analysis, susceptibility was evaluated for six insect and disease agents because they have substantial amounts of habitat (host type) in the South George planning area: defoliators (representing western spruce budworm and Douglas-fir tussock moth), Douglas-fir beetle, fir engraver, bark beetles in ponderosa pine (representing western pine beetle and mountain pine beetle), dwarf mistletoe in Douglas-fir, and root diseases (representing Armillaria and laminated root diseases).

The insect and disease susceptibility protocol (Schmitt and Powell 2005) includes evaluation factors for three other insect or disease agents (spruce beetle, mountain pine beetle in lodgepole pine, and western larch dwarf mistletoe), but they were not included in this analysis because they have limited habitat in the South George planning area.

Drought, ecological site potential (potential vegetation type), species composition and abundance, tree size, forest structure (canopy layering; structure class), stocking (tree density), intra-stand variability (clumpiness), and other biophysical factors influence susceptibility and vulnerability to insect and disease disturbances (Hessburg et al. 1999b, Lehmkuhl et al. 1994, Schmitt and Powell 2005).

Each of the six agents was rated using four to seven biophysical factors (Douglas-fir beetle, for example, had six biophysical rating factors); scores from individual factors were summed and this total score used to assign a categorical rating of low, moderate, or high. Schmitt and Powell (2005) provides the basis for assigning total score values to a categorical susceptibility rating.

The insect and disease susceptibility protocol is described in Schmitt and Powell (2005). Results of the insect and disease susceptibility assessment are summarized in Table J-16; they show that existing susceptibility is relatively high for two insect agents:

- Defoliators (western spruce budworm and Douglas-fir tussock moth)
- Fir engraver (a bark beetle species affecting true fir tree species)

Table J-16 Existing forest insect and disease susceptibility for the South George planning area

	LOW SUSCEPTIBILITY		MODERATE SUSCEPTIBILITY		HIGH SUSCEPTIBILITY	
Insect or Disease	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Bark beetles in ponderosa pine	3,410	22	10,460	68	1,570	10
Defoliators (budworm/tussock moth)	2,070	13	6,070	39	7,300	47
Douglas-fir beetle	3,680	24	11,260	73	490	3
Dwarf mistletoe in Douglas-fir	7,600	49	4,930	32	2,900	19
Fir engraver	3,640	24	4,280	28	7,510	49
Root diseases (laminated/Armillaria)	4,340	28	5,580	36	5,520	36

Sources/Notes: Summarized from the South George vegetation database (NFS lands only). Criteria for determining insect and disease susceptibility are described in Schmitt and Powell (2005). Note that susceptibility ratings were calculated for each insect or disease agent independently, so it is not appropriate to sum the acreage or percent values (down a column) by category.

HRV Analysis for Susceptibility to Bark Beetles in Ponderosa Pine

An historical range of variability (HRV) analysis was used to evaluate susceptibility to bark beetles in ponderosa pine (western and mountain pine beetles) for the South George planning area; results are provided in Table J-17. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to bark beetles in ponderosa pine was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; overstory layer size class; clumpiness; tree canopy cover; and canopy layering.

For the dry forest PVG (Table J-17a), HRV results show that bark-beetle susceptibility is below the historical range for the low and high categories, and well above the historical range for the moderate category.

For the moist forest PVG (Table J-17b), HRV results show that bark-beetle susceptibility is well above the historical range for the moderate category, within the historical range for the high category, and below the historical range for the low category.

Even though percents and acreages are presented for the cold forest PVG (Table J-17c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-17a HRV analysis for susceptibility to bark beetles in ponderosa pine on the dry upland forest PVG

Bark Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	5-10	180-370	1	30	Below the historical range
Moderate	15-30	550-1100	75	2750	Well above the historical range
High	40-90	1470-3310	24	890	Below the historical range

Table J-17b HRV analysis for susceptibility to bark beetles in ponderosa pine on the moist upland forest PVG

Bark Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	40-70	4600-8050	29	3310	Below the historical range
Moderate	15-35	1730-4030	65	7520	Well above the historical range
High	5-25	580-2880	6	670	Within the historical range

Table J-17c HRV analysis for susceptibility to bark beetles in ponderosa pine on the cold upland forest PVG

Bark Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	55-95	140-250	30	80	No interpretation because this PVG contains too few acres.
Moderate	5-30	10-80	70	180	
High	0-5	0-10	0	0	

Sources/Notes for Tables A17a to A17c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).

HRV Analysis for Susceptibility to Defoliating Insects

An historical range of variability (HRV) analysis was used to evaluate susceptibility to defoliating insects (western spruce budworm and Douglas-fir tussock moth) for the South George planning area; results are provided in Table J-18. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to defoliating insects was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; tree canopy cover; and canopy layering.

For the dry forest PVG (Table J-18a), HRV results show that defoliator susceptibility is well below the historical range for the low category and above the historical range for the moderate and high categories. This result agrees with empirical budworm damage experienced across the Blue Mountains during the last major budworm outbreak occurring between 1980 and 1992.

For the moist forest PVG (Table J-18b), HRV results show that defoliator susceptibility is above the historical range for two categories (low and moderate) and within the historical range for one category (high).

Even though percents and acreages are presented for the cold forest PVG (Table J-18c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-18a HRV analysis for susceptibility to defoliating insects on the dry upland forest PVG

Defoliators Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	40-85	1470-3120	11	390	Well below the historical range
Moderate	15-30	550-1100	53	1940	Above the historical range
High	5-15	180-550	37	1350	Above the historical range

Table J-18b HRV analysis for susceptibility to defoliating insects on the moist upland forest PVG

Defoliators Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	5-10	580-1150	14	1640	Above the historical range
Moderate	20-30	2300-3450	34	3920	Above the historical range
High	35-90	4030-10350	52	5950	Within the historical range

Table J-18c HRV analysis for susceptibility to defoliating insects on the cold upland forest PVG

Defoliators Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	40-95	100-250	19	50	No interpretation because this PVG contains too few acres.
Moderate	15-25	40-60	81	210	
High	5-10	10-30	0	0	

Sources/Notes for Tables A18a to A18c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).

HRV Analysis for Susceptibility to Douglas-fir Beetle

An historical range of variability (HRV) analysis was used to evaluate susceptibility to Douglas-fir beetle for the South George planning area; results are provided in Table J-19. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to Douglas-fir beetle was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; overstory layer size class; clumpiness; and tree canopy cover.

For the dry forest PVG (Table J-19a), HRV results show that Douglas-fir beetle susceptibility is below the historical range for the low and high categories, and well above the historical range for the moderate category.

For the moist forest PVG (Table J-19b), HRV results show that Douglas-fir beetle susceptibility is below the historical range for two categories (low and high), and well above the historical range for one category (moderate).

Even though percents and acreages are presented for the cold forest PVG (Table J-19c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-19a HRV analysis for susceptibility to Douglas-fir beetle on the dry upland forest PVG

Douglas-fir Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	35-75	1290-2750	23	830	Below the historical range
Moderate	15-30	550-1100	69	2530	Well above the historical range
High	10-25	370-920	9	320	Below the historical range

Table J-19b HRV analysis for susceptibility to Douglas-fir beetle on the moist upland forest PVG

Douglas-fir Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	30-60	3450-6900	23	2670	Below the historical range
Moderate	20-40	2300-4600	75	8660	Well above the historical range
High	10-30	1150-3450	2	170	Below the historical range

Table J-19c HRV analysis for susceptibility to Douglas-fir beetle on the cold upland forest PVG

Douglas-fir Beetle Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	45-95	120-250	71	180	No interpretation because this PVG contains too few acres.
Moderate	10-25	30-60	29	70	
High	5-10	10-30	0	0	

Sources/Notes for Tables A19a to A19c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).

HRV Analysis for Susceptibility to Douglas-fir Dwarf Mistletoe

An historical range of variability (HRV) analysis was used to evaluate susceptibility to Douglas-fir dwarf mistletoe for the South George planning area; results are provided in Table J-20. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to Douglas-fir dwarf mistletoe was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; overstory layer size class; and canopy layering.

For the dry forest PVG (Table J-20a), HRV results show that Douglas-fir dwarf mistletoe susceptibility is within the historical range for the low and moderate categories, and above the historical range for the high category.

For the moist forest PVG (Table J-20b), HRV results show that Douglas-fir dwarf mistletoe susceptibility is within the historical range for two categories (low and moderate) and slightly below the historical range for one category (high).

Even though percents and acreages are presented for the cold forest PVG (Table J-20c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-20a HRV analysis for susceptibility to Douglas-fir dwarf mistletoe on the dry upland forest PVG

Douglas-fir Dwarf Mistletoe Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	25-55	920-2020	26	960	Within the historical range
Moderate	15-40	550-1470	21	780	Within the historical range
High	20-35	730-1290	53	1930	Above the historical range

Table J-20b HRV analysis for susceptibility to Douglas-fir dwarf mistletoe on the moist upland forest PVG

Douglas-fir Dwarf Mistletoe Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	30-65	3450-7480	56	6380	Within the historical range
Moderate	20-45	2300-5180	36	4150	Within the historical range
High	10-20	1150-2300	8	970	Below the historical range

Table J-20c HRV analysis for susceptibility to Douglas-fir dwarf mistletoe on the cold upland forest PVG

Douglas-fir Dwarf Mistletoe Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	40-90	100-230	100	260	No interpretation because this PVG contains too few acres.
Moderate	20-30	50-80	0	0	
High	0-10	0-30	0	0	

Sources/Notes for Tables A20a to A20c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).

HRV Analysis for Susceptibility to Fir Engraver

An historical range of variability (HRV) analysis was used to evaluate susceptibility to fir engraver for the South George planning area; results are provided in Table J-21. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to fir engraver was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; overstory layer size class; clumpiness; and tree canopy cover.

For the dry forest PVG (Table J-21a), HRV results show that fir engraver susceptibility is above the historical range for the moderate and high categories, and below the historical range for the low category.

For the moist forest PVG (Table J-21b), HRV results show that fir engraver susceptibility is well above the historical range for the high category, within the historical range for the moderate category, and below the historical range for the low category.

Even though percents and acreages are presented for the cold forest PVG (Table J-21c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-21a HRV analysis for susceptibility to fir engraver on the dry upland forest PVG

Fir Engraver Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	45-90	1650-3310	30	1090	Below the historical range
Moderate	10-30	370-1100	47	1730	Above the historical range
High	5-10	180-370	23	850	Above the historical range

Table J-21b HRV analysis for susceptibility to fir engraver on the moist upland forest PVG

Fir Engraver Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	30-70	3450-8050	22	2500	Below the historical range
Moderate	20-40	2300-4600	20	2350	Within the historical range
High	10-20	1150-2300	58	6660	Well above the historical range

Table J-21c HRV analysis for susceptibility to fir engraver on the cold upland forest PVG

Fir Engraver Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	5-15	10-40	19	50	No interpretation because this PVG contains too few acres.
Moderate	25-60	60-160	81	210	
High	30-55	80-140	0	0	

Sources/Notes for Tables A21a to A21c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).

HRV Analysis for Susceptibility to Root Diseases

An historical range of variability (HRV) analysis was used to evaluate susceptibility to root diseases (Armillaria and laminated) for the South George planning area; results are provided in Table J-22. It summarizes the current amount of each tree density category by potential vegetation group (PVG), and the historical range is also shown.

Susceptibility to root diseases was rated using the following factors (Schmitt and Powell 2005): forest cover type; canopy species composition; and overstory layer size class.

For the dry forest PVG (Table J-22a), HRV results show that root disease susceptibility is close to what would be expected – the low category is just below the lower limit of the historical range, the moderate category is within the range but right at the upper limit, and the high category is just above the upper limit of the historical range.

For the moist forest PVG (Table J-22b), HRV results show that root disease susceptibility is above the historical range for the low category, and within the historical range for both the moderate and high categories.

Even though percents and acreages are presented for the cold forest PVG (Table J-22c), there are no HRV interpretations reported for this PVG because it has too few acres in the South George area to support a credible HRV analysis.

Table J-22a HRV analysis for susceptibility to root diseases on the dry upland forest PVG

Root Disease Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	30-60	1100-2200	29	1080	Just below the historical range
Moderate	25-50	920-1840	50	1840	At upper edge of historical range
High	5-20	180-730	21	760	Just above the historical range

Table J-22b HRV analysis for susceptibility to root diseases on the moist upland forest PVG

Root Disease Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	5-15	580-1730	27	3080	Above the historical range
Moderate	20-50	2300-5750	33	3740	Within the historical range
High	35-65	4030-7480	41	4690	Within the historical range

Table J-22c HRV analysis for susceptibility to root diseases on the cold upland forest PVG

Root Disease Susceptibility	Historical Range		Current Amount		HRV Interpretation
	Percent	Acres	Percent	Acres	
Low	35-70	90-180	71	180	No interpretation because this PVG contains too few acres.
Moderate	20-45	50-120	0	0	
High	5-15	10-40	29	70	

Sources/Notes for Tables A22a to A22c: Current amounts are summarized from the South George vegetation database (NFS lands only). Upland forest potential vegetation groups (PVG) are described in Table J-1 and Powell et al. (2007). Susceptibility criteria are described in Schmitt and Powell (2005). Historical ranges are taken from Schmitt and Powell (2008).