

Table S1 Sequences of mutagenesis primers used in this study. The modified codon is shown in bold and the nucleotide mismatches are shown in red. Primers used for IVA mutagenesis are appended with “IVA” in the name.

Primer name	Sequence
R200A_IVA_Fwd	ATCGAAGGCAAG GCC GCCAGTTACCAGGCTACC
R200A_IVA_Rev	CTTGCCTTCGATATCCTGCTC
Y203A_Fwd	AGCGTGCCAGT GCC CAGGCTACCAAGG
Y203A_Rev	TGGTAGCCTGG GCA CTGGCACGCTTGC
E216A_IVA_Fwd	GGTTGCTGG CCG CGGACAGCATCCGGCG
E216_IVA_Rev	CCAGCAACCGGGCG
R281A_IVA_F	GCAGCGTTTT CCG CACCGAGGTGAATAACCAGC
R281A_IVA_R	GAAAACGCTGCGCGAG
T282A_IVA_Fwd	GCGTTTTCCGC GCC GAGGTGAATAACCAGCAG
T282A_IVA_Rev	GCGGAAAACGCTGCG
E283A_IVA_Fwd	TTCCGCACCG CGG TGAATAACCAGCAGATTCC
E283A_IVA_Rev	CGGTGCGGAAAACGCTG
D312A_Fwd	GGCG CCG ACTTCACCGAGCC
D312A_Rev	TGAAGTC GGC GCCCTTGCCTTTG
D313A_Fwd	GGGCGAT GCCT TACCGAGCC
D313A_Rev	TCGGTGAAG GCAT CGCCCTTGC
F314A_Fwd	AGGGCGATGAC GCC CACCGAGCCCCGC
F314A_Rev	GGGGCTCGGT GCGC TATCGCCCTTG
R318A_IVA_Fwd	CTTCACCGAGCCC GCCG TGGCGAAGATCCGGC
R318A_IVA_Rev	GGGCTCGGTGAAGTCATCG
N332A_IVA_Fwd	AAGCAGTTGGAAAACG CCG TGAAGTGCAATACCTGC
N332A_IVA_Rev	GTTTTCCAAGTCTTCAGCTC
R333A_Fwd	TTGGAAAACAAC GCCG GAAGTGCAATACCTGCAGG
R333A_Rev	GTATTGCACTTC GGCG TTGTTTTCCAAGTCTTC
R341A_IVA_Fwd	ATACCTGCAGGCT GCCA AAGGGCGAGGAGCGCTTC
R341A_IVA_Rev	AGCCTGCAGGTATTGCACTTC
E344A_Fwd	AAAGGGCG CGG AGCGCTTCTTCG
E344A_Rev	GCTCC GCG CCCTTTCGAGCC
Y203F_IVA_Fwd	AAGCGTGCCAGTT TCC AGGCTACCAAGGAAGG
Y203F_IVA_Rev	AACTGGCACGCTTGCC
E216D_IVA_Fwd	GGTTGCTGG ACG CGGACAGCATCCGGCG
D312E_IVA_Fwd	CGCAAGGGCG AGG ACTTCACCGAGCCCCG
D312E_IVA_Rev	TCGCCCTTGCCTTTGAG
F314Y_IVA_Fwd	AAGGGCGATGACT AC CACCGAGCCCCGCGTG
F314Y_IVA_Rev	AGTCATCGCCCTTGCCTTTG
R318K_IVA_Fwd	CTTCACCGAGCCC AAGG TGGCGAAGATCCGGC
N332Q_IVA_Fwd	AAGCAGTTGGAAAAC CAAG CGTGAAGTGCAATACCTGC
R333K_IVA_Fwd	CAGTTGAAAACAAC AAGG AAGTGCAATACCTGCAGG C
R333K_IVA_Rev	GTTGTTTTCCAAGTCTTCAGC

R341K_IVA_Fwd	ATACCTGCAGGCT AAG AAGGGCGAGGAGCGCTTC
E344D_IVA_Fwd	GCTCGAAAGGGCG AC GAGCGCTTCTTCGAAAACATC
E344D_IVA_Rev	TCGCCCTTTCGAGCCTG

Table S2 Sequences of primers used in this study for generating deletion, complementation, and chimeric constructs. The template-binding region is underlined and restriction sites are bolded.

Primer Name	Sequence	Description
Z1_Swp138-146_Z2_F	AGAAGGACCCC <u>CAGGCGGCGCCTTTC</u> <u>TACACCGTGATCTTTGAAAAGCAC</u>	Swaps residues 138-146 of Wzz ₁ with residues 133-145 of Wzz ₂ . The homologous primer regions are highlighted.
Z1_Swp138-146_Z2_R	GGGGTCCTTCT <u>TCAAGTCCGCTGCT</u> <u>GTATTCCATTTCTTCAGAAAGATTCCG</u>	
Z2_Del_141-144_F	AGAAGGACCCC <u>TTCTTCCGCTTGTC</u> <u>ATGCAG</u>	Deletes residues 141-144 of Wzz ₂ . The homologous primer regions are highlighted.
Z2_Del_141-144_R	GGGGTCCTTCT <u>TCAAGTCCG</u>	
Z1_ins_QAAP_IL_F	GGCGGCGC <u>CTCGCTACACCGTGATCT</u> <u>TTG</u>	Inserts amino acid sequence QAAP between E145 and R146 of Wzz ₁ . The homologous primer regions are highlighted.
Z1_ins_QAAP_IL_R	GCGCCGCC <u>TGCTCACGCTCATCCTTA</u> <u>CTAGG</u>	
Z2Del271-279_IVA_F	GGAGAGTTCGCACC <u>GAGGTGAATA</u> <u>ACC</u>	Deletes residues 271-279 of Wzz ₂ . The homologous primer regions are highlighted.
Z2Del271-279_IVA_R	GGTGCGGAACTCTCC <u>CAGTGCGCCC</u>	
Z2_L4_Flex_Swap_F	GGGGATCAGGAGG <u>GGGAGGGTTCCG</u> <u>CACCGAGGTGAATAAC</u>	Replaces residues 271-279 of Wzz ₂ with the amino acid sequence GGGGSGGGG. The homologous primer regions are highlighted.
Z2_L4_Flex_Swap_R	CCTCCTGATCCCC <u>CTCCCCCTCTCCC</u> <u>AGTGCGCC</u>	
Z2_L4_Rig_Swap_F	ATGCTGCAGCTAA <u>GGCGGCCTTCCGC</u> <u>ACCGAGGTGAATAACC</u>	Replaces residues 271-279 of Wzz ₂ with the amino acid sequence AAEEAKAA. The homologous primer regions are highlighted.
Z2_L4_Rig_Swap_R	TTAGCTGCAGCAT <u>CAGCCGCCTCTCC</u> <u>CAGTGCGCCCGG</u>	
O13_Z1Up_Flank_F	<u>ACCTGTTCAAAGACTGATCAGCATGC</u> <u>TAAAAGAG</u>	Primers to amplify the upstream fragment of the Wzz ₁ deletion construct. Region homologous to the downstream fragment is highlighted.
O13_Z1del_R_Soe	GCGCGAGACCTTCTAACGGCTTCTTC TGTCACA <u>ACTAGTCCGTCTTTGATTGG</u>	
O13_Z1del_F_Soe	CTAGTTGTGACAGAAGAAGCCGTTAG AAGGTCTCGCGC <u>AAAAATAGTC</u>	Primers to amplify the downstream fragment of the Wzz ₁ deletion construct. Region that is homologous to the upstream fragment is highlighted.
O13_Z1Dn_Flank_R	<u>TTTGACCAGCTGAGAACTACATACG</u> <u>CACCC</u>	
O13_Z1Up_F_EcoRI	<u>TGACGAATTCACCCATCAGGGGCAA</u> <u>CTGTCCGCG</u>	Primers to amplify the entire Wzz ₁ deletion construct. Added restriction sites are shown in bold.
O13_Z1Dn_Rev_XbaI	<u>AGCTTCTAGACGGATGATAACCTATG</u> <u>CTTTGAGCCTTATGGG</u>	
O13_Z2Up_Flank_F	<u>GTTGTAGGGGCGAACCAGGCGGAG</u>	Primers to amplify the upstream fragment of the Wzz ₂ deletion construct. Region homologous to the downstream fragment is
O13_Z2del_R_SOE	AGGTCCC <u>GAAAGGCTAAGCTGTGA</u> GGAAGGCATA <u>CCAACGTCC</u>	

		highlighted.
O13_Z2del_Fwd_SOE	TATGCCTTCCTCACAGCTTAGCCTTC CGGGACCT GAGACCAAAG	Primers to amplify the downstream fragment of the Wzz ₂ deletion construct. Region that is homologous to the upstream fragment is highlighted.
O13_Z2Dn_Flank_R	TCCTTGCTGCCATTGCTCGATCGC	
O13_Z2Up_Fwd_EcoRI	AGCTGAATTCTACCAGGAGAGAAAC GCTCATGCCTTGC	Primers to amplify the entire Wzz ₂ deletion construct. Added restriction sites are shown in bold.
O13_Z2Dn_Rev_XbaI	AGCTTCTAGAGGTTCTGCCCCTGGTT GTCGACGG	
O13_Wzz1Fwd_EcoRI	AGCTGAATTCAGTGACAGAAGAAAC CTTTTCCAGC	Primers to amplify full-length Wzz ₁ . Restriction sites are in bold.
O13_Wzz1_Rev_XbaI	AGCTTCTAGACTATTTTGC GCGAGAC CTTCTAACG	
O13_Z2_Fwd_EcoRI	TCGAGAATTCTATGCCTTCCTCACAG CTTCCG	Primers to amplify full-length Wzz ₂ . Restriction sites are in bold.
O13_Z2_Rev_XbaI	CATGTCTAGATCAGGTCCCGGAAAG GCTC	
Z1_TM1_R_SOE_Z2	CTGGTAGGTCGGAACACTTAAAAAGG CATA TGTCCC	Reverse primer to amplify the Wzz ₁ TM1 region (residues 1-50) and add a region homologous to the Wzz ₂ periplasmic region (yellow).
Z2_Prpf_F_SOE_Z1	TATGCCTTTTTAAGTGTCCGACCTAC CAG GTGG	Primers to amplify the Wzz ₂ periplasmic region (residues 49-391) and add a region homologous to the Wzz ₁ TM1 and TM2 regions (yellow and green, respectively)
Z2_Prpf_R_SOE_Z1	CAGCACTAGAAGTATCTTGCGCGGC T GATC	
Z1_TM2_F_SOE_Z2	CAAGCCGCGCAAGATACTTCTAGTGC TG GGTGC	Forward primer to amplify the Wzz ₁ TM2 region (residues 320-349) and add a region homologous to the Wzz ₂ periplasmic region (green)
Z2_TM1_R_SOE_Z1	CTCATAAACCGGCTTGGCCAACAGCG CG TAG	Reverse primer to amplify the Wzz ₂ TM1 region (residues 1-48) and add a region homologous to the Wzz ₂ periplasmic region (yellow).
Z1_Prpf_F_SOE_Z2	CGCGCTGTTGGCCAAGCCGTTTATG AG G	Primers to amplify the Wzz ₁ periplasmic region (residues 51-319) and add a region homologous to the Wzz ₂ TM1 and TM2 regions (yellow and green, respectively)
Z1_Prpf_Rev_SOE_Z2	CCACCACCAAGGCTCCCTTCTCGGG CG AAC	
Z2_TM2_F_SOE_Z1	CGCCCGAAGAAGGGAGCCTTGGTGGT GC CCTTG	Forward primer to amplify the Wzz ₂ TM2 region (residues 392-442) and add a region homologous to the

		Wzz ₁ periplasmic region (green)
Z2_F_FLAG_N_IVA	AAAGACGATGACG <u>ACAAGCCTTCCTC</u> <u>ACAGCTTCCG</u>	IVA primers to add a FLAG tag to the N-terminus of Wzz ₂ , using wzz ₂ -pherd20T as a template. Homologous regions of the primer are highlighted yellow
Z2_R_FLAG_N_IVA	CGTCATCGTCTTT <u>GTAGTCCATAGAAT</u> <u>TCTTATCAGATCCCATGG</u>	

Table S3 Homologs of O13 Wzz₁ and Wzz₂ used to generate an MSA. The Accession, and GI sequences for each sequence are given. The percent identity (PCID) to the O13 Wzz₁ or Wzz₂ is shown.

Species	Accession	GI	PCID Wzz ₁	PCID Wzz ₂
<i>Pseudomonas</i>	WP_028698674.1	GI:655289472	39.3	18
<i>Pseudomonas</i>	WP_060514541.1	GI:983330316	37.7	16.2
<i>Pseudomonas</i>	WP_087092368.1	GI:1198982522	35	18.9
<i>Pseudomonas</i>	WP_092197691.1	GI:1224169516	35.1	16.4
<i>Pseudomonas</i>	WP_102684332.1	GI:1332654438	15	34.6
<i>Pseudomonas</i>	WP_102684334.1	GI:1332654440	34.2	18.6
<i>Pseudomonas alcaligenes</i>	WP_083700870.1	GI:1180181518	36	20.8
<i>Pseudomonas benzenivorans</i>	WP_090444700.1	GI:1222392540	44.9	18.5
<i>Pseudomonas chlororaphis</i>	SDS58113.1	GI:1085883455	38.4	17
<i>Pseudomonas chlororaphis subsp. piscium</i>	AVO60423.1	GI:1364858823	39.3	17.4
<i>Pseudomonas deceptionensis</i>	SEE98527.1	GI:1089097821	17.3	41.4
<i>Pseudomonas donghuensis</i>	WP_010224133.1	GI:497909977	15.2	39.2
<i>Pseudomonas donghuensis</i>	WP_010224134.1	GI:497909978	39.4	18.4
<i>Pseudomonas donghuensis</i>	KDN97867.1	GI:641461310	16.8	39.7
<i>Pseudomonas entomophila</i>	WP_011532778.1	GI:499852044	34.3	17.2
<i>Pseudomonas extremorientalis</i>	WP_083351555.1	GI:1179583345	16	39.8
<i>Pseudomonas fluorescens</i>	WP_057713773.1	GI:951328000	41.9	18.6
<i>Pseudomonas furukawai</i>	WP_003458269.1	GI:489553670	20.9	48.7
<i>Pseudomonas fuscovaginae</i>	SEI23467.1	GI:1093277890	15.5	40.5
<i>Pseudomonas helleri</i>	WP_088500293.1	GI:1210505805	15.8	41
<i>Pseudomonas koreensis</i>	WP_083368292.1	GI:1179600091	17.1	42.5
<i>Pseudomonas kuykendallii</i>	WP_090225885.1	GI:1222170723	33.1	18.4

<i>Pseudomonas kuykendallii</i>	WP_090231723.1	GI:1222176593	21	45.6
<i>Pseudomonas lundensis</i>	WP_094988732.1	GI:123683160	16.5	42.4
<i>Pseudomonas mandelii JR-1</i>	AHZ68776.1	GI:635286031	15.3	40.2
<i>Pseudomonas mucidolens</i>	SDU95947.1	GI:1086080869	15.4	37.8
<i>Pseudomonas mucidolens</i>	WP_084378137.1	GI:1180957500	15.3	40.6
<i>Pseudomonas oleovorans</i>	WP_074859164.1	GI:1124576746	17.9	45.9
<i>Pseudomonas pelagia</i>	WP_096347522.1	GI:1246429560	29.6	19
<i>Pseudomonas poae</i>	WP_105696847.1	GI:1358900923	14.4	36
<i>Pseudomonas putida</i>	WP_009407565.1	GI:496914543	15.9	39.9
<i>Pseudomonas putida</i>	WP_014592020.1	GI:504404918	36.7	18.8
<i>Pseudomonas putida</i>	WP_058541039.1	GI:966532312	39.6	21
<i>Pseudomonas putida</i>	WP_069942143.1	GI:1072320209	39.8	18.9
<i>Pseudomonas putida</i>	WP_103462906.1	GI:1337998616	13.9	98.6
<i>Pseudomonas segetis</i>	WP_089358910.1	GI:1219343216	38.8	19.4
<i>Pseudomonas</i> sp. 1239	WP_088514052.1	GI:1211613052	14.7	34.8
<i>Pseudomonas</i> sp. ACN8	WP_095943962.1	GI:1243218902	34.1	16.3
<i>Pseudomonas</i> sp. ATCC 13867	WP_015478627.1	GI:505291525	20.1	45.3
<i>Pseudomonas</i> sp. DrBHI1	WP_088851820.1	GI:1214579283	35	16.4
<i>Pseudomonas</i> sp. DrBHI1	WP_088851822.1	GI:1214579285	15.4	31.7
<i>Pseudomonas</i> sp. Ep R1	WP_079305324.1	GI:1159758603	40.6	19.6
<i>Pseudomonas</i> sp. FSL W5-0299	WP_077747951.1	GI:1149195551	38	19.5
<i>Pseudomonas</i> sp. GM21	WP_007942594.1	GI:495217817	16.7	40.8
<i>Pseudomonas</i> sp. GM48	WP_007985394.1	GI:495260639	37	18.3
<i>Pseudomonas</i> sp. GM74	WP_008049008.1	GI:495324263	35.6	19.4
<i>Pseudomonas</i> sp. GW456-11-11-14- LB2	WP_102643277.1	GI:1332593823	39.2	19.3

<i>Pseudomonas</i> GW456-E7	sp.	WP_102700290.1	GI:1332681941	38.6	16.4
<i>Pseudomonas</i> HMSC063H08	sp.	OFQ79174.1	GI:1080918678	44.3	19.2
<i>Pseudomonas</i> HMSC066A08	sp.	WP_070747362.1	GI:1092830961	18.7	98.9
<i>Pseudomonas</i> HMSC069G05	sp.	OFQ30146.1	GI:1080867084	49.1	19.6
<i>Pseudomonas</i> HMSC11A05	sp.	WP_070581731.1	GI:1092635972	48.8	18.9
<i>Pseudomonas</i> Irchel 3E13	sp.	WP_095155502.1	GI:1237014924	33.7	17.4
<i>Pseudomonas</i> Irchel 3E13	sp.	WP_095155722.1	GI:1237015144	16.9	40.8
<i>Pseudomonas</i> Irchel s3b6	sp.	WP_095143914.1	GI:1237002759	39.8	19.2
<i>Pseudomonas</i> LAMO17WK12:I8	sp.	SNT23956.1	GI:1216101759	33.6	17.5
<i>Pseudomonas</i> M30-35	sp.	WP_087516191.1	GI:1200072377	20.2	41.3
<i>Pseudomonas</i> MF6396	sp.	WP_078479769.1	GI:1154103702	16.6	38.3
<i>Pseudomonas</i> NBRC 111140	sp.	WP_060492586.1	GI:983306451	34.7	18.2
<i>Pseudomonas</i> NFR16	sp.	WP_093460654.1	GI:1225451655	46.8	19.5
<i>Pseudomonas</i> PA27(2017)	sp.	WP_075933891.1	GI:1132273813	16.7	41.9
<i>Pseudomonas</i> PIC25	sp.	WP_095601145.1	GI:1240435549	20.1	45.9
<i>Pseudomonas</i> PIC25	sp.	WP_095601146.1	GI:1240435550	20.5	47.7
<i>Pseudomonas</i> SWI6	sp.	WP_104882382.1	GI:1352974433	17.6	39.1
<i>Pseudomonas</i> TTU2014-080ASC	sp.	WP_058067976.1	GI:953983081	16.6	42.2
<i>Pseudomonas</i> UW4	sp.	WP_015093986.1	GI:504906884	39.6	18.8
<i>Pseudomonas</i> WN033	sp.	WP_095626167.1	GI:1240461238	18.9	46
<i>Pseudomonas</i> WN033	sp.	WP_095626245.1	GI:1240461316	20.6	48.2
<i>Pseudomonas</i> <i>stutzeri</i>		WP_102851015.1	GI:1332889887	21.9	46.1
<i>Pseudomonas</i> <i>stutzeri</i>		WP_102856965.1	GI:1332896113	19.7	40.6

<i>Pseudomonas yangmingensis</i>	WP_093477159.1	GI:1225468176	20.2	43.8
--------------------------------------	----------------	---------------	------	------

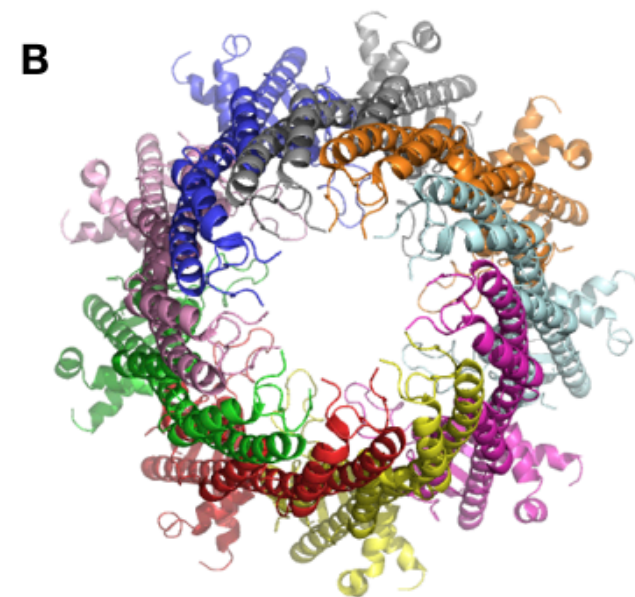
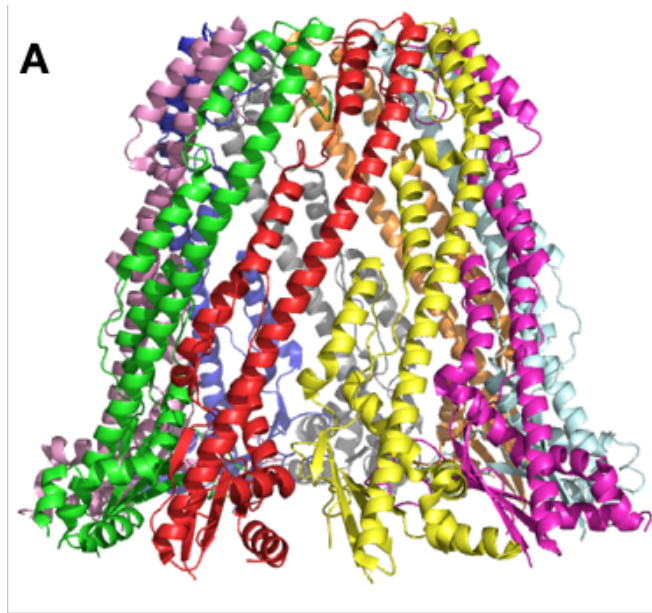


Figure S1 Head-on (A) and top-down (B) views of octameric FepE from *E. coli* (PDB ID: 3B8M). Individual protomers are separately colored.

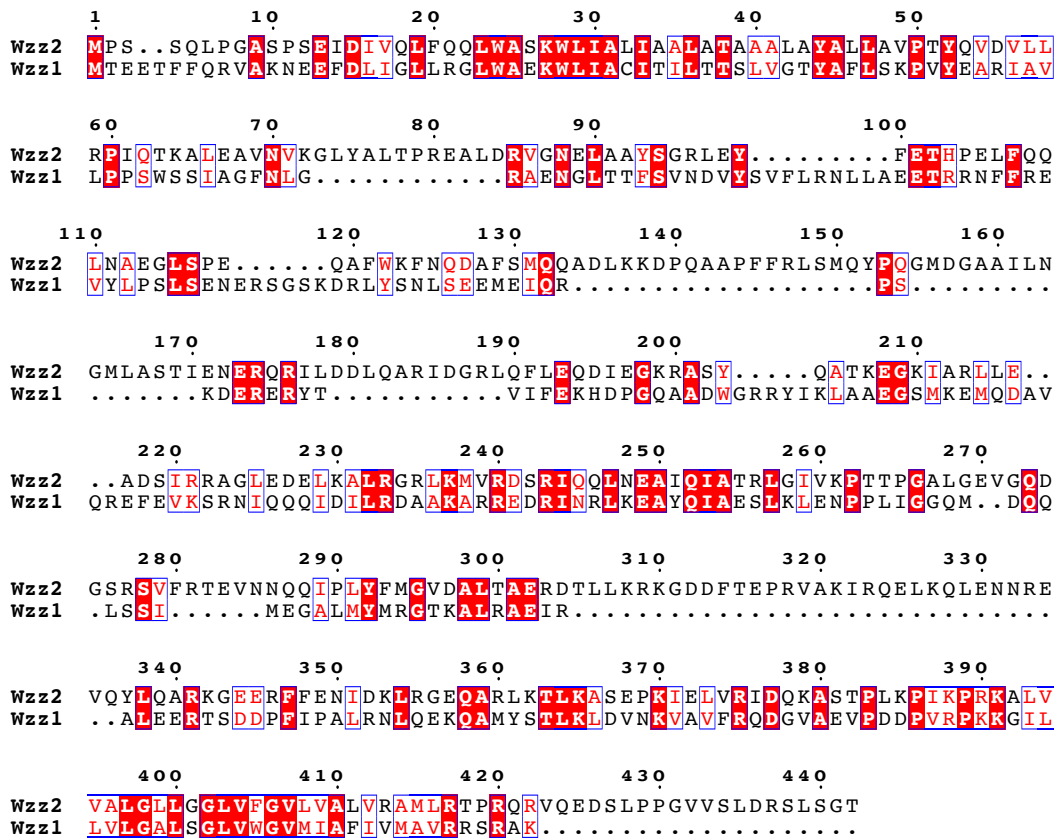


Figure S2 Multiple sequence alignment of Wzz₁ and Wzz₂ from *P. aeruginosa* IATS O13. Identical residues are coloured white with a red background and similar residues are coloured red with a white background.

WP_103462906.1/1-459
WP_104882382.1/1-434
WP_088514052.1/1-496
KDN97867.1/1-468
WP_078479769.1/1-454
WP_088851822.1/1-452
WP_009407565.1/1-451
WP_010224133.1/1-445
WP_095155722.1/1-411
SEE98527.1/1-443
WP_088500293.1/1-447
WP_105696847.1/1-435
SEI23467.1/1-450
WP_083351555.1/1-458
SDU95947.1/1-478
WP_084378137.1/1-454
WP_094988732.1/1-456
WP_102684332.1/1-464
AHZ68776.1/1-435
WP_083368292.1/1-426
WP_070747362.1/1-442
O13Wz2/1-442
WP_075933891.1/1-437
WP_090231723.1/1-427
WP_058067976.1/1-443
WP_087516191.1/1-448
WP_007942594.1/1-445
WP_003458269.1/1-427
WP_015478627.1/1-434
WP_074859164.1/1-427
WP_093477159.1/1-432
WP_095626167.1/1-430
WP_095626245.1/1-424
WP_102856965.1/1-423
WP_095601146.1/1-435
WP_095601145.1/1-425
WP_102851015.1/1-435
WP_095943962.1/1-360
SNT23956.1/1-381
SDS58113.1/1-345
WP_087092368.1/1-349
WP_092197691.1/1-355
WP_077747951.1/1-351
WP_008049008.1/1-353
WP_079305324.1/1-357
WP_057713773.1/1-356
WP_007985394.1/1-344
WP_102700290.1/1-347
WP_095143914.1/1-353
WP_015093986.1/1-360
AVO60423.1/1-351
WP_102643277.1/1-351
WP_010224134.1/1-358
WP_093460654.1/1-355
WP_102684334.1/1-353
WP_060492586.1/1-347
WP_095155502.1/1-368
WP_088851820.1/1-352
WP_014592020.1/1-350
WP_060514541.1/1-353
WP_011532778.1/1-346
WP_069942143.1/1-352
WP_028698674.1/1-358
WP_058541039.1/1-356
WP_090225885.1/1-350
OFQ79174.1/1-345
WP_070581731.1/1-344
O13Wz1/1-349
OFQ30146.1/1-348
WP_090444700.1/1-394
WP_096347522.1/1-371
WP_083700870.1/1-372
WP_089358910.1/1-358

.....
..MERGAI RWHNACKLTRQCALWLYSASSPIAYRCLSVRHGTYISARAGLN
.....MVCRRGRALNPTDRDLFG
.....MSLFIQADLR
.....MRINSRQV
.....MSGYFEVFPDRPSGD
.....MSRISQVSHG
.....MFTI
.....MFIL...SSHL...DKRSNNKVRFL
.....MP...QSKRP...AEQDVL LTRRLF
.....MT
.....MSSFRAPLVRPSNG
.....MNGTPQLQSHVGS
.....MSSFRAPPVSLSDH
.....MTSISRIPSGSSD
.....VVTSNQFP SLGLV
.....MGPAAVFFRLEGRS
.....MLSFILERT
.....MNLPAKIRSENH
.....MPSSQLPGASPS
.....MPSSQLPGASPS
.....MPHVPTARSQHD
.....MLNNP TVSPRRDD
.....MNDVTPSSRTGA
.....MDAS
.....MSHAES
.....MNGPVVRPQQFSD
.....MNA P LPPTRRSD
.....MSTEPAKPYEPTAD
.....MQTGAT
.....MSQYTPLPQQPAST
.....MPQYGNND
.....MAMQOVNASTD
.....MDLPVNT
.....MKS R VHNKE
.....MQNSN...STVNSSV
.....MRND LERRSSDSE
.....MSSNS...SSPVTDD
.....MVLFM
.....MQSDA...ANNQDAN
.....MQNSH...GSQSSND
.....MQVGS...SNSVND
.....MQDNR...VEGRSAD
.....MLQLS...TASTSSD
.....MG
.....MQGDS...REEKNVDFEF
.....MQSSS...AGACSSS
.....MQETS...SLPAGAN
.....MRGDS...MANKKDE
.....LKY
.....MQDGRFENRADADA
.....MTTSSRY...SQDAD
.....MQNIR...GG.ADVG
.....MAS...EQYRGGE
.....MRNDR...ECRDKDH
.....MRNER...ERRSG.ESD
.....MRNDL...ERFKQER
.....MRNER...SREVGND
.....MNVVQ...DGRERAG
.....MRNDR...ERLEGKS
.....MRNDQ...GRLADDN
.....MAQDC...ERLIASD
.....MLTQRG...TADSSY
.....MTADG
.....MTTERSPRVPI
.....MTEETFFQ
.....MTENRYS...RQDADG
.....VTDNNDYQHQAPRND
.....MIYCNHIGAN
.....MIOGHSSARAS
.....MKTGTAS

1 1Q 2Q
MKLDPRGSYRDASG EVDLFDLFRILWRRR
...MDLGLGFLQTLWNKK
VTSVSRIPPIAQQ EFDLFLATAQVWVQK
TNIISRVPVVAHD ETDLIAMIQS IWRQK
LASISRIPSVVTS EFDLTLTLLQA VWRQK
IVESLGA VLSRRV EFDL FVIAQT IWRQK
MSGYFEVFPDRPSGD DLDLFWALFQS LWRQK
EVDLLYVVKI IWTQK
...MFTI
LTTYHNPKAQKPGP EIDL FELLAHSF WQK
LKNTEHPRPKASSP EIDLVDLFSF WQK
...MAHT IWKHR
VSSISHAPLVISAHQ LDFELLRIVKSK
MSSFRAPLVRPSNG IDL FVALSKF VWRQK
LNKTPQLQSHVGS EIDL FELFQS IWRQK
MSSFRAPPVSLSDH IDL FVLSQA IWRQK
MTSISRIPSGSSD EIDL IALFQA IWRQK
VVTSNQFP SLGLV EFNLFSAALWHGR
MGPAAVFFRLEGRS EIDL IREILKS VWRQK
MLSFILERT MNLPAKIRSENH EIDL IALLRD IWRQK
MPSSQLPGASPS EIDL I VQLFQQ LWASK
MPSSQLPGASPS EIDL I VQLFQQ LWASK
MPHVPTARSQHD EIDL I GE LIRA LWERK
MLNNP TVSPRRDD EIDL I VELIRA LWRQK
MNDVTPSSRTGA EIDL L LAVA LWGSR
MDAS MNARVSHGPESNSD EIDL FALINS LWLOR
MSHAES LPPRPPIVPSFNTH EIDL SE L FST LWRQK
MNGPVVRPQQFSD EVDL VALFKD LWKQK
MNA P LPPTRRSD EIDL IALCGS LWAYK
MSTEPAKPYEPTAD EIDL V L FQK LWQK
MQTGAT VSDLTPOAH.FHDD EIDL FELAEN LWKEK
MSQYTPLPQQPAST EIDL VALAHG LWQK
MPQYGNND EIDL LALFES LWEQK
MAMQOVNASTD EIDL VALFOA LWRQK
MDLPVNT ISAHLPVQPV LND EIDL LAELFRS LWAKK
MSDRQQYSPHED EIDL LAELIRS LWQK
MKS R VHNKE LGKT VQHQTSTPE EIDL V L FRA LWRQK
MQNSN...STVNSSV ELD I FEI FG VWRK
MRND LERRSSDSE EVDL LEFLEG VWRQK
MSSNS...SSPVTDD EVDL RV LFGT LWLQK
MVLFM SNGA...VDFSSAD EVDL KRIFFV LWQK
MQSDA...ANNQDAN EFDL FQIARA LWSQL
MQNSH...GSQSSND EIDL YEIFQE IFSQK
MQVGS...SNSVND GLDL HALAHT LWRQK
MQDNR...VEGRSAD EIDL I E LVRG LWAKK
MLQLS...TASTSSD EIDL I FVLIKA LWVQK
MG EIDL I SDIFRV LWKKK
MQGDS...REEKNVDFEF QRFVRA I LWRQK
MQSSS...AGACSSS EIDL QALVRS LWRQK
MQETS...SLPAGAN EIDL KVLAYV LWRQK
MRGDS...MANKKDE EVDL QELVRV LWDKK
LKY MRDS...NSGSEGLG EIGL ADL FKG VLAQR
MQDGRFENRADADA DIDFVELLRL LWAGK
MTTSSRY...SQDAD EIDL IEVARE LWQK
MQNIR...GG.ADVG EMDLITL IAVLWGEK
MAS...EQYRGGE EVDL GELFKS VWAQK
MRNDR...ECRDKDH EIDL LAMLEL LWRQK
MRNER...ERRSG.ESD LFDLLEW LWRK
MRNDL...ERFKQER EFDL I FDLTEG VWRQK
MRNER...SREVGND DLDVLELWV LWRK
MNVVQ...DGRERAG EIDL IE L LV LFKEW
MRNDR...ERLEGKS VVDL V LIEE LWRQK
MRNDQ...GRLADDN EIDL IE L VEG VWRQK
MAQDC...ERLIASD DIDL IE L IKG LWQK
MLTQRG...TADSSY HLDLFDYLRLL LHRW
MTADG EVDL VKLVKE LWVKK
MTTERSPRVPI IDG I DLV LLAQ I LWRQK
MTEETFFQ RQVAKNE EFDL IGLRGLWAEK
MTENRYS...RQDADG EIDL LALVQG LWAGK
VTDNNDYQHQAPRND EIDL V L FYG LWMQK
MIYCNHIGAN VTTIKKTPPHSSND ELDL L DVAQD LWQK
MIOGHSSARAS ETDL L LELVLL LWEQK
MKTGTAS VNRITAEQSHASD EIDL V L VQK LWLQK

3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q
WP_103462906.1/1-459 A F I V A I G V F F A I I G V A L A Y V . I P P E Y E A S T T L R P V E L N Q L D A L N R S K I Y . S L P P E E A L K R V G A R L D S Y N A R L E Y
WP_104882382.1/1-434 V Q I G A S A C L A G L L A G G Y A F M . L T P E Y Q V S T V L R P A A L N D L D G L N R S K V Y . T L T P N Q A L N R I G A S L D S Y D T R L G Y
WP_088514052.1/1-496 K L I V A F S L M F A A L G G I Y A F T . A T P E Y E T S A V L R P S V A L N D L D A L N R S G V Y . S L S P D E A L M R V A S A L D S Y E V R L G F
K D N 9 7 8 6 7 . 1 / 1 - 4 6 8 K L I A S A A L L V G V I A G A Y A F I . T T P E Y E V G T V L R P A A L N D L D A L N R S E V Y . S L P P G S A L V R V G A A L D S Y D T R L N Y
WP_078479769.1/1-454 K L I V I C S L F F G V I G A L F A Y T . V T P E Y E V S T I L R P A A L N D L D A L N R S E I Y . S L P P S T A L I R V G A A L D S Y D T R L G Y
WP_088851822.1/1-452 L L V A T V A L V F T A M C V Y A Y L L A T P V Y Q V K S I L R P A S Q S L D A L K R T G L Y . D V S P A S A L L R F G A A L D S Y D T R K A F
WP_009407565.1/1-451 L I V G F V L V A G A C S V G Y A M L . S T P I F Q A H S I L K P A P I N E L D A L N R S E V Y . T L P P A A A L A R I A S S L G S Y E M R L S F
WP_010224133.1/1-445 R I V L S V L I A A L F A L V Y C F F F L V P V Y Q V T S V L R P V P M N D L D A L N R S G L Y . S L S S E K A L K K V A S T L D S Y D T R L R F
WP_095155722.1/1-411 G L I G A A A A L V G L L F A I Y A F F I A T P V Y Q V T S V L R P V A L N D M D A L N R S A L Y . S L S P E A A L L R V G T A L D S Y E A R L S Y
S E E 9 8 5 2 7 . 1 / 1 - 4 4 3 K L I A A T A L A G F M A L G Y A L W . A Q P V Y Q T S S L R P V A I N E L D A L N R S E V Y . K L P P E A A L L K V G S A L D S Y D T R L N Y
WP_088500293.1/1-447 K F I A T T S A I A G A I A L G Y V L V . V Q P I Y Q A S T V L R P A E I N E L D A L N R S E V Y . K L P P N E A L L K V G A A L D S Y E T R L S F
WP_105696847.1/1-435 R F V L V S A V G A G L I A Y T F A S M . I T P Q I Y V A K S I L R P A A I N E L D A L N R T Q V Y . Q L S P G E A L I N V G A S L E S Y D T R L G F
S E I 2 3 4 6 7 . 1 / 1 - 4 5 0 N I V F S V A F I F V L M A V A Y V F F . V T P I Y Q V S S V L R P A A I N E L D A L N R S G I Y . K L P P G E S L Q R V G A L D S Y E T R L R F
WP_083351555.1/1-458 K L L L L V T L G C G L I A A C Y A F L . V T P T Y K V S A A L R P A A I N E L D A L N R S E V Y . Q L P P V D A L L K V G A A L D S Y D T R L A F
S D U 9 5 9 4 7 . 1 / 1 - 4 7 8 K L V I G C T F V G L L G V Y A L L . A P R E Y R V S S V L R P A A I N E L D A L N R S E V Y . K L P P A D A L L K V G S Q L D S Y D T R L S F
WP_084378137.1/1-454 L C I V A V A A G F G L V A A Y A Y V . A T P E Y H V S S V L R P A A I N E L D A L N R S D I Y . K L P P G A A L K K V G A S L E S Y D T R L G F
WP_094988732.1/1-456 K I I I A T T I S G M M A L G Y A Y Y . A T P E Y Q V T S V L R S A A I N E L D A L N R S G V Y . T L P P S E A L M K V G A S L E S Y D S R L G F
WP_102648329.1/1-464 R I V L A T T A L A T I A A L T Y A F . L V T P S Y K V S V L R P A A I N E L D A L N R S G V Y . S L T P P E A L M R V G A A L D S Y E T R L R F
A H Z 6 8 7 7 6 . 1 / 1 - 4 3 5 A I V L L F S G L G F V A A V T Y V T . L A T P E Y E V N T S L R P V S N T D L D E L N E S G V Y . K I H P E A A L Q R I G S L M E S Y D V R L N F
WP_083368292.1/1-426 G L I I G T L V S T A I A V T Y V L . T A K P Q Y K V Q N S I T P V A S A L D L D E L N E S G L Y . K I E P Q E A L L K V G S A L D S Y Y V R L Q F
WP_070747362.1/1-442 W L I A L I A A L A T A A A L A Y A L . L A V P T Y Q V D V L L R P I Q T K A L E A V N V K G L Y . A L T P R E A L D R V G N E L A A Y S G R L E Y
O 1 3 W z 2 / 1 - 4 4 2 W L I A L I A A L A T A A A L A Y A L . L A V P T Y Q V D V L L R P I Q T K A L E A V N V K G L Y . A L T P R E A L D R V G N E L A A Y S G R L E Y
WP_075933891.1/1-437 K L I I G V A A V V T L L S V V A L . L A T K Y R T Q S T L R P V A M N V L D E L N A S G L Y . E L T P E E A L Q R V G A G I S S Y E R L E Y
WP_090231723.1/1-427 F L I A G I T F A T L I A L A A Y A L . M A T P Y Y Q T Q T L R P A S A K D L D E L N S S G L Y . K L S P E E A L K R V G A G I D S Y E R L E F
WP_058067976.1/1-443 F L I L G C T A C V L G A S V Y L Y . T A L P Y Q V T S V L P P A I N E L D A L N G T K L F . T L T P E A A L L R V G T A L S W E N R L A F
WP_087516191.1/1-448 W L I A G V M A L L A T A A G T Y A L . L A T P Y Y Q A Q S V L K P T S L K S F D Q L N L T G V Y . K V D R D Q V L N R I G I S L E S Y S T R Y D F
WP_007942594.1/1-445 Y L I A G I T L A A A M A A Y A Y . T A T P Q Y Q T K T L R P P S I K D L D A L N Q T G V Y . T L N P E E S L K R V G A A L N S Y E V R K S Y
WP_003458269.1/1-427 L V L A I T G L A T I A A A V Y A F . T A T P Y Y K V S V L R P A A I N E L D A L N G S G L Y . S L T P K Q A L R N V G D A L S Y S L R M K Y
WP_015478627.1/1-434 F L I L G V T L F I V A C S A L Y A T . L A T P Y Y Q V S V L R P I A L K D L D G L N E T K L M . E L S P A K A L S Q V G A L E S Y S V R L Q F
WP_074859164.1/1-427 Y L I I A C T L A V A I C A A G Y A W . L A T P H Y Q V Q S M L R P A P L K E L D E L N S T G V Y . P L T P E A A L Q R V G A A L D S Y S S R L Q F
WP_093477159.1/1-432 I L I A L V T A V V T F I A L A Y A L . L A T P Q Y Q T Q S T V R P T V V K S L D E L N R L G V Y . K L K P G E A L A L V A A E L D S Y E A R L D Y
WP_095626167.1/1-430 V I G I A A V I V T L L A S I Y A W . F A T P H Y E Q S V L R P A A I K D L D E L N A T G L Y . S L K P E A A L R R V G A A L D S Y D V R L N Y
WP_095626245.1/1-424 W L I A A I T A V V T V L A I G Y A F . L A T P Y Y E T Q S T L R P A A I K D L D E V N A S G I Y . E I T P E E A L H R V G S A L D S Y E T R L N Y
WP_102856965.1/1-423 I L I A I V T L A C A A V A G Y A F . L A T P Y Y K T T T Y L R P S D R S L D Q L N E T G I Y . K L A P D E A L G R V A S L S Y D L R R E F
WP_095601146.1/1-435 L L I A A I T A S A L L A A S Y A F F I A T P E Y Q V S V L R P A A I K D L D A L N G T E V Y . P L T P D E A L R V G T A L D S Y E T R L E F
WP_095601145.1/1-425 L L I A G V A L G V T L L A A Y A F . L A T P Y Y K V Q S V V R P V D Q G A L D A L N G T E I Y . E L T P S D A L A R V A A A L S Y E N R L K Y
WP_102851015.1/1-435 L I V I G V T L I V T L I A A Y A F . L A T P Y Y E T K Y L R P V P H S L D Q L N E T G I Y . K L T P E E A I N R V A S G L S Y D N R L E F
WP_095943962.1/1-360 W M V V G T A L C G L V A G V Y A F . L T T P Y E S R Y Y I F P P T V N D I A L N F G R A . E R S E L K . P F T V D Q Y K I F L R N L Q S E S O R R A F
S N T 2 3 9 5 6 . 1 / 1 - 3 8 1 L L I F L V T V A V T A V A L A Y A L . L A K P V Y E A K I F L A A P A T S D I A D L N Y G R T . Q O T G L E . P F T S R K V F D I F V E L N G E T I L R R Q F
S D S 5 8 1 1 3 . 1 / 1 - 3 4 5 W I V I S V T I F V T L I A L C Y A F . L A K P I Y E S K I Y V A P T Q S E I S N F N Y G R I . N E M G L S . A F S V G L V Y K I F L R N L Q S E S R L Q A F
WP_087092368.1/1-349 K L I V I C I A F V V V F F S V C Y A F . F K V P L Y E A K V Y V V P P T Q D I S N L N Y G R T . S E S E L P . Y F T V K E I Y S T F L F N L Q S E S V R R S F
WP_092197691.1/1-355 W V I I S V T A I A V L G M M Y A F . F S E R V Y E A R A Y V P P T Q S D I A D L N V G R T . K E F D L E . P Y T I E H Y R L F L R N L L S E S L R Q E F
WP_077747951.1/1-351 R I L I L I T V T C L L A A V I Y A Y . L A K P V Y E A R A F V P P K Q S I A D L N F G R D . K K S D M D . P F T V K E Y S V L R N L Q S E S L R K R E L
WP_008049008.1/1-353 I V I L C A A L L G T F V A A S Y A F . L A E P L Y E A K A F V I P P T Q N D I E N L N Y G R I . D Q S K L P . Q F T V K D Y V S V F L K N L Q S E S L R Q F
WP_079305324.1/1-357 L I I I G V A L V I T A G A A Y A F . V S K P V Y E A K S F I L P P T Q N G I A E L N Y G R G G K S S D L Y . P S I Q Y V Y D V F A R N L Q S E S L R Q T F
WP_057713773.1/1-356 W V V I S V I I L V T I A S A V Y A F . T A K P L Y E A R I Y V L P P T Q N D I A D F N Y G R T . L N S D L P . P F T V K D Y V D V F V R N L F S E S L R R S F
WP_007985394.1/1-344 W T I F A T S V V T L I A V A Y V F . L A R P V Y E A S A I T M P P T Y K D I A N L N Y G R G . S E T E L V . P I T V K D Y S I F L Q S L Q E T I R Q T F
WP_102700290.1/1-347 Y I I L A A T L A G A V A A S Y A F . V A T P I Y E A K A F V P P T Y K D I A N L N Y G R T . K D T E L A . P Y S V K D Y V D V F L R N L R A E T L R R D F
WP_095143914.1/1-353 W L V I L S I A V T T L V A A V Y A Y . T A K P V Y E A K I F L P P T A N D I A S I N Y G R T . Q D S D L E . P L K V K D Y V Q V F L R S L Q S E T L R Q D F
WP_015093986.1/1-360 F I I I A I T A V V T I L A A S F T F . F S K P I Y E A K V F I P P T Q N D I A N Y N Y G R T . L E N E L S . P Y T I K E Y V S V F T R N L M A E S L R R E F
A V O 6 0 4 2 3 . 1 / 1 - 3 5 1 V W I L I F T L L S V L F A A F A F . L S R P E Y E A K G Y V V P P T Q K D I E D F N Y G R T . K G S E L A . P Y T I K D Y G V F I S Y F Q A E S L R Q D F
WP_102643277.1/1-351 W L V I A V T V V I T L M A G A F A Y . L S Q P V Y E A R A Y V L P P T Q N D I E D F N Y G R T . P E L G F A . P Y S V R D Y V A V F I R N L Q S E S L K N R F
WP_010224134.1/1-358 F L I L L V T L V F G L F G L G Y V F . I T K P V Y E A K V S I P P T Q S Q I A E L N Y G R T . S E S G L D . P Y S L K D Y V D V F L R N L Q A E L R R E F
WP_093460654.1/1-355 T L I I L I T L V I T V A V G A Y A F . L S K P V Y E A K L F L Q P P T Y N S I A D F N Y G R T . K E A E L D . P Y S V K D Y V D V F I R N L Q S E S L R R K F
WP_102684334.1/1-353 I L V V G V A L V I T L A S I G Y A F . F A S P L F E A K V Y V Q P P F A H D V A R L N Q G R G . G D S G L K . L I S P K D A Y A I F L D C L N S E F L R R K F
WP_060492586.1/1-347 V L I A G L T L A L L L A A L Y A F . T R Q P V Y Q A D L A I V A P S H N D I S L I N Y G R G . E A T G L A . V I T V K D V Y E L Y A R H L Y S E N A R R K V
WP_095155502.1/1-368 A V V F V I V F L A V A L S L F Y I V . V R V P V Y E A K A I V E A P A Q E N I S Q L N Y G R G . G E S G L P . L L T T G D V Y E I Y V H H L L S E S O R R K F
WP_088851820.1/1-352 V T I F L A T L A G G G L A A I Y A W . T V A P V Y E S K V I V Q P P V Q T D I A R L N Y G R G . N G S G L S . L F S V K D Y V G V Y V R N L Q S E S L R D F
WP_014592020.1/1-350 W L V L V T V A V V A V F A I Y A I . A V T P V Y Q A K L N V Q P P L D S I N Q L N Y G R S . D G K G L L V P I T A K F V N D V Y L R N L Q S N V L R Q M F
WP_060514541.1/1-353 L I L L S S I A L V T V A A F V Y V S . L K T P L Y E A K S F I L P P T K N D I A Q L N Y G R T . E A S G L E . I F T P K D V Y E I Y L R S L Q S E S L R Q F
WP_011532778.1/1-346 L L V V K V A S L V F A L G L V Y V F . Y V P S R Y E A K L F T I P P T Q N D I A Q L N Y G R G . G S A E L P . L I S V G D V Y S S Y V R N L N S E S M R M E F
WP_069942143.1/1-352 W V V A L T A V V T L I G V A Y A L . L A T P I Y E A K V F V Q P P S Q R D I A Q L N Y G R G . G D S G L P . I L S V K A Y V E S Y V R Y V Q S E A V R D F
WP_028698674.1/1-358 L W V A V I A P I V L V G L A Y A L . L A P R V Y Q A R L F V P P S R D E I A Q L N Y G R G . G D S G L S . T Y S V K D Y V D V Y V R E L N S E T V R S K F
WP_058541039.1/1-356 M L I M V T T A V I F L S A L A Y A L . L A R P A Y E A K V F V Q P P T Q N D I A H F N Y G R G . P D T G L D . T L T V K D I Y D V Y V K H L Q S E S L R R S F
WP_090225885.1/1-350 R W V A G P T L A A L A C A G L Y L L . L T A P V Y Q A R T T L L P P T P A S I A F Y N Q D N G . . R A G L P . V W D S D A Y V S A F Q K Y L Q S D S L R L S F
O F Q 7 9 1 7 4 . 1 / 1 - 3 4 5 V L I L L T L L A L I G S F T Y A Y . L S K P V Y E Y R V A V V P P A L G S I E G F N V G R R . . E N G L D . A Y T V R S I Y A I F S R N L L S D E N K K E F
WP_070581731.1/1-344 W L I A S F F L L A T A L A V Y A F . Y S R P I Y E A R A S V L P P S L N E I S G F N L G R K . . E S D L G . V F S V K D I Y D V F I R N L M A E E T R Q N F
O 1 3 W z 1 / 1 - 3 4 9 W L I A C I T I L T S L V G T Y A F . L S K P V Y E A R I A V L P P S W S I A G F N L G R A . . E N G L T . V F S V N D Y V D V F L R N L L A E E T R R N F
O F Q 3 0 1 4 6 . 1 / 1 - 3 4 8 W I V I G T A V V T L L A V Y A V . L K E P V Y E S K I T L P P P L S A V A G F N I G R T . R S E G L A . P F T V S D Y R V F T R N L E A D E N R R A F
WP_090444700.1/1-394 W L I L L V T L V S V G A T S Y A L . L A K P V Y E S R V T V M P P S L S E I A D F N L G R N . G G T G L K . P F S V G E Y V A V F T R N L Q A E K N R R Q F
WP_096347522.1/1-371 Y L I A V I T V A V M L I A V G Y A F . L A T P V Y Q S T V S V I P P R A A D I A P V N L G R E . . R A E I D . E L D I K E A Y S I F T R N L N S Q T S R R W F
WP_083700870.1/1-372 L I V I A I T M L L G A A A Y A Y . L S P R F Y E T K A S V L P P R L S E I S A Y N L G R V . . E A G L E . E F K V D D Y V A V F T R N L T S Q A L R Q R F
WP_089358910.1/1-358 W L I I G C T V L I T A L A A Y A F . L S T P T Y Q A S A G V M P P R L S E I A G Y N L G R S . . E A R K L N . E F T V E D Y G V Y K R N L S G S L K R Q E

110 120 130 140 150 160 170
WP_103462906.1/1-459 FRSRPEIVEA.FRDGGQSFEEQAFQGFN NSTALSVVQADPKK.GNLLSDFIGLKMRYGKDINGAVLNDFVDYAVELEBRAQL
WP_104882382.1/1-434 FRTNPPELREA.FVTPGRSEEEQGFHEFNRSALRVIQPDSKK.ADLLTTFIFIGLDRYPKGIIDGHHVNLGLVQYAIQKRESV
WP_088514052.1/1-496 YKANPQLQEQ.FVGAYSAPTHAFERFN RDLMKVQTDVQK.SAAFATSVNMQMRYPQGISGPDALNGLIEYAIQKRESV
KDN97867.1/1-468 FRANPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSSFIGLQLRYPKGVKGEELNGLVQYAIENERKQI
WP_078479769.1/1-454 FRSNPDIOAA.FTRPGYTAEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_088851822.1/1-452 YEQHQNFFESP.YKRAGLTDQVLRMNTTEMLKVVMPPVAER..DFGQGRLOITMTYPEGVNGVRMLNDYVAFVKGEEAV
WP_009407565.1/1-451 FRENQQLFAP.YIIPNQSIQQSFDAFNRSVIALDALDVGKDAADFARAVNLTDYDPKGVVDGAFILNKFVDYVIEARQHI
WP_010224133.1/1-445 FRANPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095155722.1/1-411 FRANEALFKP.YLRAGMSVEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
SEE98527.1/1-443 FRTHEQDLFKP.LERQGISLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_088500293.1/1-447 FRSHQDLFKP.LEKEGMLTEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_105696847.1/1-435 FRANQNLFKN.FVQPGRSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
SEI23467.1/1-450 FRANPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_083351555.1/1-458 FRANQALFEP.FVRPGQTLTEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
SDU95947.1/1-478 FKANQALFEP.FVQPGRSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_084378137.1/1-454 FRENKLFEE.FFRPGRTLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_094988732.1/1-456 FRDNQELFRQ.FKRPGRTLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_034582629.1/1-464 FRAHPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
AHZ68776.1/1-435 FKTYPQYLLAP.LQAPGKSIQQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_083368292.1/1-426 FQANPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_070747362.1/1-442 FETHPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
O13Wzz2/1-442 FETHPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_075933891.1/1-437 FANQPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_090231723.1/1-427 FRKNQELFRQ.FKRPGRTLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_058067976.1/1-443 ALANKAERLSP.FSDSDGSEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_087516191.1/1-448 FQKHPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_007942594.1/1-445 FDKHQEQFSG.IDSG.DLTLQAFERFNSEAFKVLQPDPAK.QGNLAPFVGRIRLTYPRGVDGPEAVNGLVHAIINVRSQV
WP_003458269.1/1-427 FHENPELFA.FFRPDQTAEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_015478627.1/1-434 FRDNQELFAA.LRVGDKSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_074859164.1/1-427 FRDNQALFEP.LKKGDKSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_093477159.1/1-432 YRNNRELFPSE.LESESRLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095626167.1/1-430 FNRHQEQFNV.LLRNGRTPLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095626245.1/1-424 YRDNQELFVSS.LNKTGRSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_102856965.1/1-423 FRQHPDLFEP.LMRDGRPDQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095601146.1/1-435 SRAHPELFA.LQTPLRSEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095601145.1/1-425 FRENQALFAP.LAESGRSLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_102851015.1/1-435 FLNHQELFQV.IPQRGDSPLEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_095943962.1/1-360 FESTYLPAAEGGDATS.VSSGSLYAEFNSK.SMTVEPVGKEEDG...RWSVSLRHSNPEERSVAWLTSYVAVGESTARELI
SNT23956.1/1-381 FKEFYMPSSVAG.Q.GAQQALYAAVNG.SFVYVQLA.GEPP...RAYVAFRGRDPAVSRWATAYVEKAGAAKAEV
SDS58113.1/1-345 FNEVYLPGLDGERE.RSEEQVFAEFNRSSLLKLVQDPDKK.ADLLSAYIGFQMRYPKGVGRGHDLNGLVQYAIENERKQI
WP_087092368.1/1-349 FNDIYLPSLDATTRK.RSESALYSEFTK.RLVVSSPG.KDLAE...RYQVVMQGDSPAKSAELLDKFIIRAGEAAKREL
WP_092197691.1/1-355 FESTYLPAAEGGDATS.VSSGSLYAEFNSK.SMTVEPVGKEEDG...RWSVSLRHSNPEERSVAWLTSYVAVGESTARELI
WP_077747951.1/1-351 FLSMLPTFTAEAEK.QSQQVLYAQFTS.KLITAPSS.KDLDPD...RYSVSEFQHSASQTAEWLLDIYKRAAGEAAKQEI
WP_008049008.1/1-353 FKNTYLAAGKGS.E.DPKGRLYEKLSK.NLVISMVG.KDALD...RYSVVLNNDEEMGAKWIEQLLARAQQALQOEI
WP_079305324.1/1-357 FNDIYLPSLDESQR.GALDRLYVRFSR.ELVTKGSPS.KTTPD...RFSVTVOGGDPEVRAETWVKAYKRASEAASELI
WP_057713773.1/1-356 FDEVYLPSLTENARK.GSRDRLYQNFSK.QLVSVGG.KEGPD...RYSVTVOGYNPESEAGEWVRTYQNAAGVAAKNEM
WP_007985394.1/1-344 IAENVMAPGSSKDEGE.ARSNLYSELSK.LLVVSVQTR.KDLPD...EYVVTIQSSNPDAQANWQAEYIHRAGKLAEQEI
WP_102700290.1/1-347 FKVYLPVLSLSEDRK.QSDVLYADFSQ.LRVVVSPLKEASD...RYLVVVQTSNPEQARNWAAEYIAKAGDLAKNEM
WP_095143914.1/1-353 FKSXYLPVLSLSDAHE.AEQDLSLYSSYLK.QLVVKLPT.KDAGD...RAYVVMENDSPDEALSLWAKAYVHDASVMAKAEI
WP_015093986.1/1-360 FNNVYLPVLSLSEGRS.GSQDLYYAEFSK.LLMVALVN.KESSD...RYVVMQNESAAKGVLELVGKYIERASELAKKEI
AVO60423.1/1-351 FNNVYLPVLSLSEGRS.GAQDGLYAGFSK.RLSIALPS.KDFAD...RYSITVRSDSPAQSVVWVHQYVARASDLAKREL
WP_102643277.1/1-351 FNEVYLPVLSLSDARR.GSQDYLYRKFITA.ALTIAQPS.KDFSD...RFTVVALNNQPVQANWLNLYIDQASDAAKKEI
WP_010224134.1/1-358 FNTHYLPVLSLGAAD.ASKDKLYERFGK.TLRVVSAG.KAEPD...RYVFSFQAGSPEEAQQLWLEYTKAGINARDEV
WP_093460654.1/1-355 FDDVYLPVLSLPKDKQE.GSRDLLYAALLA.DLTA.PV.RGSSD...RYEISARTNDPSVAQWITTEYLKRAADDVKAEM
WP_102684334.1/1-353 FLEYYLPVLSLQGRS.SRELLLYARFNK.LLAVAE...SQAPE...RYSIAMROSTPVMAAEWLSRYMQMANEAAKAAI
WP_060492586.1/1-347 FEEIFFPSLSESKA.QPQNVLFTRFSR.LFVLSKGT.DDAAA...RYVVSVDSEFAAAVKLADALANTAEEMTKSEL
WP_095155502.1/1-368 FESVYLPVLSLSEVQRR.GAVDLYRGFAR.LLQVVLQS.KSPA...RYSVSVKLPDPEQALWVKQYIEMAEVAAKAEV
WP_088851820.1/1-352 FLKYLPVLSLSEDRRA.GSQDGLYRFLKE.AVTLKGDG.KEASG...RWTVVVRSDDARRSVEVAQAFVEMAAARTKLEV
WP_014592020.1/1-350 YKRNYLPVLSVENVGE.ESQAGLYAKFNS.QFLVGVHQ.SE.Q...YATVTLAEDPKQAADWAVRYAEMAGEQSKKEL
WP_060514541.1/1-353 FRTVYLPVLSPEAARQ.GSQDLYYRFGK.VLTVGVVQ.DSAGS...RILVRLASDDPEMSVKKVTRFSEMSADRAKKTL
WP_011532778.1/1-346 FNDVYLPVLSLAEKQKT.SLRSDLYRQFFA.ALSILQGG.KDQSD...RYLITASSSSPEEAAKWVKQYIEMAGDRAKREI
WP_069942143.1/1-352 YREVYLPVLSLPEADR.GAQDLYYRFSK.AVSIAPAAT.KDSPE...RFQIVASSTDPQQAADWIVAYVQLAGDRAKKEV
WP_028698674.1/1-358 YRTVYEPALTGNERV.GSRDLYYRFLS.KLTVQVTK.KDGNP...RYVIAASTEDNQAAQWVAAAYEMASELAKKEV
WP_058541039.1/1-356 FQATYLPVLSLQGRS.SRELLLYRFFNK.LLIVAVAA.KDTPD...RFAITANVYSPQQAQWVAAAYEMASELAKKEV
WP_090225885.1/1-350 FRETVPVLSLSEQR.RPEGALYRRAFDT.LLQVAVLAD.RLKPY...ILQVLDVLSQEQQAADWIVAYVQLAGDRAKKEV
OFQ79174.1/1-345 FYKIYLPVLSLQGRS.SRELLLYRFFNK.LLIVAVAA.KDTPD...RFAITANVYSPQQAQWVAAAYEMASELAKKEV
WP_070581731.1/1-344 FKEKYLPTLGDGK.A.ESLDALYRNFND.ELQIKASM.DGSG...RYLISAVAHESDTAAYLVDSYIEMVAGISKNEM
O13Wzz1/1-349 FREVYLPVLSLSEGRS.SKDRLYSNLSE.EMEIQRPS.KDERE...RYTVEFKHDTGAADWGRYIKLAEGSMKEM
OFQ30146.1/1-348 FRLYLPVLSLSEDRK.GPQDGLYRFFNE.IFTIKVPD.KQQPG...YTLIIEKRNPEAAADWVQKYIQMVAKQSLDEM
WP_090444700.1/1-394 FREVYLPVLSLSEGRS.SKDRLYSNLSE.EMEIQRPS.KDERE...RYTVEFKHDTGAADWGRYIKLAEGSMKEM
WP_096347522.1/1-371 FEERYLPVLSLQGRS.SRELLLYRRAFDT.LLQVAVLAD.RLKPY...ILQVLDVLSQEQQAADWIVAYVQLAGDRAKKEV
WP_083700870.1/1-372 FDEVYLPVLSLQGRS.SRELLLYRRAFDT.LLQVAVLAD.RLKPY...ILQVLDVLSQEQQAADWIVAYVQLAGDRAKKEV
WP_089358910.1/1-358 FDEVYLPVLSLPAEDAG.AAKDKLWDRFNS.DFSVQAPDAKNNPD...YFVVKVEGIEQVEVVAEWANKYIKMAADKSEEGM

18Q 19Q 20Q 21Q 22Q 23Q 24Q 25Q
WP_103462906.1/1-459 SRD M Q I I L A N R L A E V D A K L N S A L T E Y R T G N E G R I A R L E E S D T I K R A Q L N D E L K A L R V Q L R L Q R Q A R L A E L D E A I S I A R S L
WP_104882382.1/1-434 A E D L N V I V N N R I K E I D D E L V S A R A E Y D I A K K S Q I A A L Q E D D E V K R G Q L N D E L R A L R V Q L K L R R A D R I A Q L D E A I A I A R S L
WP_088514052.1/1-496 S D D L K V I V S N R L A E V D A K L A A A R S N Y D A T K Q G R I A E L L E A D R L K R A Q L Q D E L K A L R S Q L K L L R E D R I A Q L N E A I T I A R S L
K D N 9 7 8 6 7 . 1 / 1 - 4 6 8 A D D L K V I I G N R L A E V D A K L A A A R A A Y E S S K D S K I A V L L E G D N L K R A K L V D E L K A L R V Q L K I Q R D D R V A Q L D E A I S I A H S L
WP_078479769.1/1-454 S D D L K V I I G N R L K E V D A K L V A A A R A D Y D A T K E S N I A E L L E S D S L S R A L Q D E L K A L R V Q L K Q R R E D R I S V L D E A I N I A R S L
WP_088851822.1/1-452 R H D V E S T R R S R V E G L A S E I D S L Q M V Y E H E K S A Q I A K L R E Q N I L R R A V L Q D E L G A L R V E L K T Q R A N R L H E L E A I A V A R S L
WP_009407565.1/1-451 S A D V S A L I K N R L A E I Q G K I D V A R A N Y Q M D K E A K I A A L I E A D N V R R A R L Q D E L S A L R V Q L K L L R A D R I A V L N E A I S I A R S L
WP_010224133.1/1-445 K A D M T V I V N N R M A E L A A Q L S A A R V A Y S S G K E S L I A G L L E Q D G L K Q A Q L Q D E L K A L R Q Q L K L N R I A R M Q Q L A E A I G I A R S L
WP_095155722.1/1-411 Q A D F D V I I K N R L N E V A A Q I D A Q R A V Y D G D K K S Q I A R L L E Q H N L K R S L L E D E L N A L R Q Q L K V Q R S N R I S E L S E A I S I A R S L
S E E 9 8 5 2 7 . 1 / 1 - 4 4 3 S A D L K V I I N N R L R E L E A K I N S A A R S Y R E A E T G E I A T L L E A D T R K K A E L E D E L Q A L R L E L K I E R D A R V A Q L D E A I S I A R S L
WP_088500293.1/1-447 S S D L K T I I N N R Q K E L R E K I S A A R L G Y Q S D K E A K I A T L E E D D E L K R A T L K D E L Q A L R L Q L K A M R E A R I D Q L D E A I S I A S T L
WP_105696847.1/1-435 A A D L K V I V A N R L L E I D G K Y Q A A K A S Y E V D K E A K I E S L K E A D E V S Q A K L K D E L V A L D S Q L K T L R A D R I S Q L S E A I V I A Q S L
S E I 2 3 4 6 7 . 1 / 1 - 4 5 0 S A D L G V I V Q N R L N E L K E K I A A A R S Y E M D K E A K I A S L L E A D N L K R D Q L Q D E L K A L R L Q L K A E R N D R I T Q L T E A I D I A K S L
WP_083351555.1/1-458 S A D L D V I V N N R I N E L K G R F D S A R S N Y E V E K E A K I A S L R E N D A L K R A Q L Q D E L R A L R S Q L K A L R N D R I A Q L N E A I G I A K S L
S D U 9 5 9 4 7 . 1 / 1 - 4 7 8 G A D L K V I V N N R L A E L K G K I D A E R S N Y E T D K E S I A T L L E S D K L K R A Q L E D E L K A L R L Q M K M E R S N R I A E L S E A I S I A K S M
WP_084378137.1/1-454 A N D M E V I V D N R L N E I N G K L D A A R A S Y E N S K E A K I A S L M E A D T V R R A Q L R D E L K A L R A Q L K T R R A N R V A Q L D E A I G I A R S L
WP_094988732.1/1-456 A A D L K V I V N N R L N E L K G K I D A A R S S Y E N D K A A R I A T L Q E A D N L K R A Q L Q D E L K A L R Q Q L K V A R S D R M A Q L D E A I G I A K T L
WP_010284332.1/1-464 N S D I S T V V N N R L K A L D L R L Q K S R L S Y E T L K D L Q I A S L L E A D S V K R A R L D E M R A R A E L K T R R A N R I A Q L D E A I T A R R L
A H Z 6 8 7 7 6 . 1 / 1 - 4 3 5 E S N F K T L V S N R I E K I E K N L D S K K S A Y A A T T S S I A G L L E K D Q I K K Q V L Q D E L K A L R Q Q L Q T R R Q N R I K E L D E A I V I A K Q L
WP_083368292.1/1-426 E A D F N A V I K N R L A Q T E R K I S S Y R A S Y T T E K E S R I A T L L E A D D K L Q I A I L Q D E L K A L R Q Q L K T R R N D R I A Q L D E A I S I A K K L
WP_070747362.1/1-442 L D D L Q A R I D G R L Q F L E Q D I E G K R A S Y Q A T K E G K I A R L L E A D S I R R A G L E D E L K A L R G R L K M V R D S R I Q Q L N E A I Q I A T R L
O 1 3 W z 2 2 / 1 - 4 4 2 L D D L Q A R I D G R L Q F L E Q D I E G K R A S Y Q A T K E G K I A R L L E A D S I R R A G L E D E L K A L R G R L K M V R D S R I Q Q L N E A I Q I A T R L
WP_075933891.1/1-437 A E D V E V I I R N R L A K L E Q R M A S E A A Y Q A N K E A K I A S L E A N A L K R A Q L Q D E L N S R A R A E L K T R R A N R I A Q L D E A I T A K S L
WP_090231723.1/1-427 A Q D V E V I V Q N R L T K L E Q T M A E R S S Y Q A S K E A R I A A L T E A D D L K R A K L N D E L K A L R K Q L R T R R A N R I A Q L N E A I I A R S L
WP_058067976.1/1-443 E D D F N A V I K N R L A V L E R Q I S S Y R A S Y T T E K E S R I A T L L E A D S L K R A R L K D E L A L R Q M L L T R R N D R I A A L D E N I A I A K A L
WP_087516191.1/1-448 A A E V S T L V T N R L N K L Q S Q I A A A R I G Y E A D K O S K I A K L L E A D S V K R A N L M D E L A G L R Q Q L K L R R Q N R I M Q L T E A I M I A E Q L
WP_007942594.1/1-445 Q G D L N S V I D N S I D T L E R K M G V A R A S Y E A D K D S T I A K I S E N A D L K R A Q L Q D E L R A L R T E L L R D R R E S R I T Q L N E S M Q I A R L
WP_003458262.1/1-427 Q D D F D V F V N N R L T Q L Q S Q I A T E R A R S Y E A E K E I R I A E L T E A D S L K K S R L Q D E L R A L R Q Q L L Q V R R Q N R I A Q L N E A I Q I A E N L
WP_015478627.1/1-434 Q D D F N V L I K N R L T R V E R Q I A V Q R A A Y D T S K E A K I A A L L E A D S L R T I Q I T D E L K A L R Q Q L Q V R R Q N R I A Q L N E A I Q I A E R L
WP_074859164.1/1-427 A L D L E G V I K N R L N K I E R Q M A A R A S Y E A G K E A A I A K L S E D D K L Q I A I L Q D E L K A L R A E L R T H R Q N R I A Q L D E A I A I A K S L
WP_093477159.1/1-432 T A D H N A L V A S R I S E L D R K I N T A R A A Y E A E I E V R I A K L T E S D E L K R V Q L N D E L N A L R T Q L R Q R R E N R I A Q L E A I S I A S A L
WP_095626167.1/1-430 I A D L N V I I E N R L S V L D R K I I V A R A A Y E A E K S A R I A R L E E A D S L K R A E L H D E L L A L R Q E L R S K R D N R I E Q L D E A I Q I A K S L
WP_095626245.1/1-424 E T D I E V L I N N R L A T L E R R I N A A R A S Y E A E K E I R I A E L T E A D S L K R A Q L Q D E L R A L R E E L R Q R R A D R I A Q L D E A I T A S A L
WP_102856965.1/1-423 G R E V A H L A A N R L V G L E G Q I A A G R A A Y E S S K E S E I A A L L E K D A I K A A E L Q A E R D A L R I Q L T K R D N R I V Q L N E A I G I A E S L
WP_095601146.1/1-435 A A D L Q A V I K N R L D K L E R K I E A A R A S Y E T S K Q A K I A T L L E A D L K R A K L Q D E L R A L R Q L K T R R D R I A Q L N E A I R I A K S L
WP_095601145.1/1-425 A E D L K A L I A N R L A N L E Q K I E A A R A N Y N A S K E A Q I A T L L E E D A L Q R A K L Q D E L E A L R G E L K T R R E S R I S E L E A I R I A E S L
WP_102851015.1/1-435 A D D L E S L I G N R L A S L E M N M E A Q R A S Y N A S K E A K I A T L L E E S A L K R A Q L K D E L K A L R E L K T R R T N R I Q E L S E A I S I A E S L
WP_095943962.1/1-360 A Q N A K K E A V V A G R S R V L E I D T L R E S S R K I R E D N I T K I R E A L F I A Q S S
S N T 2 3 9 5 6 . 1 / 1 - 3 8 1 L H D A T R E A Q V R A N A V L Q L E D N L R E S G Q Q R E D K I I R L Q E A L Q I A T A I
S D S 5 8 1 1 3 . 1 / 1 - 3 4 5 I K N I T R E A E V R A R D V R Q Q I S V L R E S S A E K K R E D S I A Q L R E A L I V A E K I
WP_087092368.1/1-349 I K N I T R E A E V R A M N L A Q Q I A A V R E G G Q Q K R A D Y I V Q L K E A L Q V A S A I
WP_092197691.1/1-355 T K N V S Y E A K I R A Q N M D W E I N A K R D A G E A V R E D T L V K L R A A L S I A E A T
WP_077747951.1/1-351 I Q N A Q R E A Q V R A G D L E R Q I S I R R E K S L A I R E D W I V K L E A L V A E E I
WP_008049008.1/1-353 N K N I S S E Y D I E S Q N L H Q E I V S L R E I G D K T R E D S L I K L R E A L V A Q A I
WP_079305324.1/1-357 I K N V T T E A S V K A R N L E Q R I V S L R E T A K R R E D S I Q L R E A L K I A E A I
WP_057713773.1/1-356 I K N V V R E A Q V R A R N L E Q Q I N G L R E S A R R E R E D K I K V L S E A L V I A R A V
WP_007985394.1/1-344 I K N V L Y E A D V K V R S L D R Q I A D L R E N A Q K V R E D T I T K L R E A L R V A S A I
WP_102700290.1/1-347 I R N L S I E S E V R A R N L E Q Q I S S A R D A S R A V K A E D S I A R L A E A L R I A E S I
WP_095143914.1/1-353 Y K D V S S E S A V H A R N L S Q Q I D S L R E R S L K L R Q D S M T R L R E A L R V A E A I
WP_015093986.1/1-360 K K D M G S E A D V L A R I R Q Q I A S L R D V G L K D R E D S I T K L R E A L V A E A I
A V O 6 0 4 2 3 . 1 / 1 - 3 5 1 L A N V R R E A E V G A R N V E Q Q I A A L R H V S Q K E R E D S V V R L R E A L Q V A E A L
WP_102643277.1/1-351 I K N F S K E I K I R I R N N E T Q I S M M R E N A A N V R Q D T I R Q L L E A K V A G S I
WP_010224134.1/1-358 I E D A A R E A Q V R A R N I S Q Q I S T L R E S G L K M R E D L I V R L R E A L R I A R A I
WP_093460654.1/1-355 I R N V T R E A E V R A R N I E Q Q I E T L R I S G K E A Q E D S I V Q L K E A L R I A E S I
WP_102684334.1/1-353 I R G A Q V E V A L K V D S L I K K I E V A R A N A L G E R E D R M V Q L R E A L V I A E K I
WP_060492586.1/1-347 V K N A L S D A S M R A V M L D K E I I S G K R E V A R K E R E D R L I K L K E A L S I A L S V
WP_095155502.1/1-368 L E N V R S D A S T R A E N L R R E I T A E R T A K R K R E D R E A R L R E A L A V A R S I
WP_088851820.1/1-352 I E D A R S D A L V L A E S L E Q Q V E M A R E S S A R Q R K D R I A Q L K E A L K V A R A V
WP_014592020.1/1-350 I E R A V S D F K V E A D N L Q Q S I D S A R A K A R L E R D D R I A Q L T E A L K I S K S I
WP_060514541.1/1-353 V E D A D T E V K V L V K N L E Q Q V R S A R D A A H R Q R E D S I V R L R E A L K V A R A V
WP_011532778.1/1-346 L K N I Y S D A L V K A D N L E K Q I R R E Q S S A R R E R D D R I A R L T E A L V I A R S V
WP_069942143.1/1-352 I A D V R A D A L V K A E N L K E R V R S A R E G A R K E R E D R I A R L S E A L I V A Q S I
WP_028698674.1/1-358 L T G H R S E L A V K A E N L Q W E I D A A Q A S A R K L R E D Q L R E A L K V A K S I
WP_058541039.1/1-356 L K N I K S D A T V K A N N L Q R Q I L T A Q E T S R K Q R E D D I V Q L K E A L L I A K S I
WP_090225885.1/1-350 R E T V E A S I H O R G A Q L Q R Q I L L R E T A L K R R K R I A A L K E A L Q I A R S V
O F Q 7 9 1 7 4 . 1 / 1 - 3 4 5 I D S A G R D F O V R N A A M Q S R I T V L Q N M A K G R R D D R I A R L K E A L L I A E S L
WP_070581731.1/1-344 L K N I K R D L H V K S V N L E Q Q I N I M R A M A K T R R E D T I L R L R E A L K I A E A L
O 1 3 W z 1 / 1 - 3 4 9 Q D A V Q R E F E V K S R N I Q Q Q I D I L R D A A K A R R E D I N R L K E A Y Q I A E S L
O F Q 3 0 1 4 6 . 1 / 1 - 3 4 8 L Q N A R R E L D V K A Q N M R Q Q V D I L K E S A K E R R A D R I T Q L K E A L A I A K A L
WP_090444700.1/1-394 L K N A Q R E L A V H A Q N I E Q Q I D G R R E S A K A R R E D R I T Q L R E A L T V A E A I
WP_096347522.1/1-371 E L D T R A Q V A N K I R A F E E H I H A L R M T A K A E R L D V A R L R E A L K V A E A I
WP_083700870.1/1-372 Q Q N V L S E I D T R V Q A I Q K R I D V L R S G A R V Q R E D R V A R L K E A L I I A E A A
WP_089358910.1/1-358 Q T N Q L T E I G T K A Q S L A R Q V D A L R L T A E K R R K D R I A R L Q E A L I V A D A V

	26Q	27Q	28Q	29Q	30Q	31Q	32Q	33Q	
WP_103462906.1/1-459	GLK	KKP	STPSLMADEV...	SGGGNIIRTEVNGRPVP	LYFM	GTEVLEAE	RATLRK	RSD	DFVAPRIGEIRKELLLLSNRRS
WP_104882382.1/1-434	GLK	RRP	STPSSMAHSEA...	EGGGSVIRTEINNQQVP	MYFL	GTDALAEAE	KQALRE	RRTD	DFVEPRVAQIRKELMMLEQNRT
WP_088514052.1/1-496	GLK	RRP	STPSSMANS...	DSSGTINRTEVNNQOIP	LYFM	GVDALAEAE	RQVMRR	RSSD	DFSDPKVAEIRKQLLVLANNRE
KDN97867.1/1-468	GLK	KKP	SSPSSMANES...	EASTGSVIRTEVNNQOFP	LYFM	GADALAEAE	RRVLR	RRTSD	DFSDPRVAQIRKELLLLATNRE
WP_078479769.1/1-454	GLK	KKP	STPSSMANS...	EASGNVIRTEVNNQOIP	LYFM	GTDALAEAE	RQVLRK	RRTSD	DFADPRIAQIRRELSLLSNRO
WP_088851822.1/1-452	GLK	RRP	TTASLLGEGSM...	AAGVNVIRTEISSQKEP	LYFL	GTDVLEAE	QAVLRK	RSD	DFTNRRVAEIQKELQMLSVDRQ
WP_009407565.1/1-451	GIR	KKP	ATQSSLAETM...	NGSGSVIKTEVNSQQAP	LYFM	GSDALAEAE	LATLAR	RKSD	DFVTARTSEIAKELQMLQVNRE
WP_010224133.1/1-445	GIR	RRP	TPPMSLGDAAAR...	PANNVFRTEVNNQAVP	LYFM	GVDALAEAE	RAALAK	RAND	DFDGRVAQIAKELQLLQHNRO
WP_095155722.1/1-411	GIR	RRP	TPPMSLGDSDAQ...	SSSGSVRTEVSNQOIP	LYFM	GSDALAEAE	RAVLR	RRTSD	DFSTNRVAEIQKELQLLQANRO
SEE98527.1/1-443	GYT	HP	TPPMSIADSVQ...	TRSSQMRTEVTSQTMP	LYFM	GTDVLEAE	RAALLK	RRTND	DFTDERIAKTTKKLKLLEVNRR
WP_088500293.1/1-447	GIR	RRP	TPPYAMGESA...	GGGSRVIRTDITSQDTP	LYFL	GTDQALQAE	RAVLRK	RRTSD	DFTDKRVLEIDKKLKLLEVNRE
WP_105696847.1/1-435	GIR	IKP	STPSSMGEGKG...	ANGGNVMRTEITNNQMP	LYFM	GVEALAEAE	RRVLR	RRTD	GFDTGRTAQIAKELQLLKRNR
SEI23467.1/1-450	GIR	QKP	TPPSALAESG...	ASSNNIMRTEVNNQOIP	LYFM	GVDALAEAE	RKVLNR	RSSD	DFTEKRIAEIQKELLLKTNRO
WP_083351555.1/1-458	GIR	QKP	TPPSSLGESRN...	AGANSVMRTEVNNQOVP	LF	FMGVEALNAE	LVALK	RKSD	DFDTPRVAQIAKELQLLASNRE
SDU95947.1/1-478	GIT	HP	TPPSSMADAGR...	DSSSQVMRTEVNNQKIP	LYFM	GTEALAEAE	RIALQH	RRTSD	DFDTNSRIAEIQKELQMLQVNRE
WP_084378137.1/1-454	GIR	KKP	ATPSSLGADR...	GGSSVMRTEINNQQIP	LYFM	GVDALAEAE	RIALVR	RKSD	DFTEARIAEIVKELQLLEVNRR
WP_094988732.1/1-456	GIR	QKP	TPPSALGDSVR...	SGDTSVMRTEINNQQIP	LYFM	GVEALAEAE	RAALLQ	RRTD	DFTEGRIAQIAKELQLLQSNRE
WP_1023458332.1/1-464	GIR	QKP	TPPSALADNPA...	NNATSVV.VADGVSRRD	LYFL	GSDALAEAE	RAALLV	RRTSD	DFVDTRIPQIAKELQMLERNRE
AHZ68776.1/1-435	GIV	RRP	TPPSSLADVQ...	AREGNMIRTEVNNQOIP	LYFM	GQLALAEAE	RSTLVS	RRTSD	DFTEPRIDEIQKELSLAVNRK
WP_083368292.1/1-426	GIV	SP	TPPSSLADVQ...	AREGNMIRTEVNNQOIP	LYFM	GQALAEAE	RSTLVS	RRTSD	DFTEPRIDEIQKELSLAVNRK
WP_070747362.1/1-442	GIV	VP	TPPGALGEVQ...	DGSRSVFRTEVNNQOIP	LYFM	GVDALTAEAE	RDTLKR	RKGD	DFTEPRVAKIQKELQLENNRE
O13Wz22/1-442	GIV	VP	TPPGALGEVQ...	DGSRSVFRTEVNNQOIP	LYFM	GVDALTAEAE	RDTLKR	RKGD	DFTEPRVAKIQKELQLENNRE
WP_075933891.1/1-437	GID	KKP	STPSTLADSAP...	MAGSGNVIRTEVNNQOIP	LYFM	GAEALAEAE	RNAIQ	RRTSD	DFTEPRIAEIQADLRLLQVNRE
WP_090231723.1/1-427	NIV	RRP	ATPSSLGNAGQPA...	AGSQQGNVIRTEVNNQOIP	LYFM	GTDALAEAE	KAAQLK	RRTSD	DFTEPRVQIEKELQLLQSNRE
WP_058067976.1/1-443	NI	HKP	THPTSLGDAER...	VAQGSVIRTEVNTHTDP	LYFM	GTEALAEAE	RNTLSK	RRTSD	DFTEPRIAEIQKELRLLQSNRE
WP_087516191.1/1-448	NI	HKP	ATPSSMRDLGE...	QASNNLIRTEVNTHTDP	LYFM	GTEALAEAE	RNTLSK	RRTSD	DFTEPRIAEIQKELRLLQSNRE
WP_007942594.1/1-445	GIV	KKP	NTPTAMGGD...	VGQGNVFRTEVNEQFP	LHFM	GTEALAEAE	RNAIQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_003458269.1/1-427	GIA	KKP	TPPSALGDSAR...	EVQGSVIRTEVNNQOIP	LYFM	GSETLAEAE	RSALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_015478627.1/1-434	HIS	KKP	TPPSALGDNRR...	EIQGSVFRTEVNNQOIP	LYFM	GVEALAEAE	RSALQ	RRTSD	DFSEPRVSEIQKQLALLSHNRE
WP_074859164.1/1-427	GIS	KKP	NTPTSLGDVDA...	AAGQGNVFRTEVNSQOIP	LHFM	GTEALAEAE	RNIQLK	RRTSD	DFTEPKIATIQKQLQMLLQSNRE
WP_093477159.1/1-432	GIR	KKP	TPPSGMSQEQ...	STGNVVRTEVNTHTDP	LYFM	GTDALAEAE	RKALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_095626167.1/1-430	GIV	VP	TPPSTLGNQTR...	SASGNVIRTEVNNQOIP	LYFM	GTEALDAEAE	RQALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_095626245.1/1-424	NI	RRP	TPPSALGQEV...	TSGSVIRTEVNTHTDP	LYFM	GTDALAEAE	RKALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_102656965.1/1-423	GIR	KKP	SPLALNTATI...	DR.GTGQTPNTDGLTDP	LYFL	GSEALAEAE	REALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_095601146.1/1-435	GIA	KKP	TPPSALGDEGR...	SAQGNVIRTEVNNQOIP	LYFM	GTEALAEAE	RDALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_095601145.1/1-425	GIA	KKP	TPPSAMSDAQ...	SR.GQVVRTEVTSREIP	LYFM	GTEALQAEAE	RKALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_102851015.1/1-435	GIR	TP	TPPSAMAEET...	RGGAQVIRTEVNTHTDP	LYFM	GTEALMAEAE	RDALQ	RRTSD	DFTEPRIAEIQKELQLLQSNRE
WP_095943962.1/1-360	GL	ENT	VVFAGR..GS...	EKLGNMFDNT	LYMR	GSKALAEAE	LKNLE	RSD	DFTEPRIADIQSELAMLENNRE
SNT23956.1/1-381	GL	QNP	PLISGE..VS...	RALSGKMDGELT	LYMR	GSKALAEAE	IASLQ	RRTSD	DFTEPRIADIQSELAMLENNRE
SDS58113.1/1-345	GL	EVS	PAMTGG..IL...	LEMQKEGVQEQ	LYMR	GAKALAEAE	IGNLE	RASQ	DFTEPRIADIQSELAMLENNRE
WP_087092368.1/1-349	GL	LDS	PSVSGK..LF...	VEVSN.SRETP	LYMR	GAKALAEAE	IQALE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_092197691.1/1-355	GV	RRP	VMIFDG..SP...	NAAATNMTGEMS	FLRG	VEALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_077747951.1/1-351	NI	RRP	LIISGN..LS...	AEMSGSMGQQL	IYMR	GTKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_008049008.1/1-353	GL	RRP	PTVGSDDSKAS...	IGIVGNMDDGLT	LYMR	GTKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_079305324.1/1-357	GL	TRP	NTN.SS.GV...	VDDITVEADNRMD	YQ	RGSKALAEAE	INALE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_057713773.1/1-356	GL	NKP	VIIISGR..TS...	AELSLGVDSQA	LYMR	GSDALQAEAE	IDGLR	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_007985394.1/1-344	GL	KKP	PIITGN..PA...	VQIAGSDVGDQL	IYMR	GTKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_102700290.1/1-347	GL	KKP	PAITLS..QS...	V.IAGGEGQLT	LYMR	GIALKAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_095143914.1/1-353	GL	KKP	PIITGN..PA...	VELAGSDGQV	LYMR	GSKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_015093986.1/1-360	GL	RRP	PIISGN..SA...	VEIAGNLGQV	LYMR	GTKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
AVO60423.1/1-351	GL	KKP	LIITGS..SA...	IEVAGNIAGQP	VYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_102643277.1/1-351	GL	KKH	QIIAGG..VA...	GEMSGAGDSRL	IYLR	GTKALAEAE	VKTQ	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_010224134.1/1-358	GL	KKP	PLIDGA..AS...	AELAASVDGELT	LYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_093460654.1/1-355	GL	ENP	PLISGN..LS...	SEVSAMDGQV	LYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_02684334.1/1-353	GQE	KKP	VEVVDV..SV...	AE..RGGARELV	LYLR	GSKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_060492586.1/1-347	GL	RRP	PIITGS..A...	SELSARMDGDL	AYMR	GSEAIQAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_095155502.1/1-368	GL	HRP	LALSGE..VA...	AELSPGRVGVLS	LYMR	GSDALGAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_088851820.1/1-352	NIE	SP	PIVNS..LY...	GGLSADEGGAR	LYMR	GSRALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_014592020.1/1-350	GL	KKP	PIIENN..LS...	SEVSGMNGSL	LYMR	GSKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_060514541.1/1-353	SL	KKP	PIIANG..LN...	AEVSGMQGAL	LYMR	GSGALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_011532778.1/1-346	GL	VP	PIIISA...	ELTAQMNGLT	LYMR	GSDALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_069942143.1/1-352	GL	KKP	PIISGN..GN...	SELSADMEGSL	VYMR	GSRALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_028698674.1/1-358	GL	KKP	PIISGS..LS...	SEVSAMSGAL	LYMR	GSAIEAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_058541039.1/1-356	GL	KKP	PIIFGN..LS...	TEVSGMEGSL	LYMR	GSKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_090225885.1/1-350	GL	ESP	QASSMRVAAQ...	DNLASFIDGSL	LYLR	GSAIEAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
OFQ79174.1/1-345	KID	GP	PLIEGASE...	QQLSSIMDGLT	LYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_070581731.1/1-344	KI	ENP	PSFEGQTE...	QQLSSIMIGEL	LYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
O13Wz1/1-349	KL	ENP	PLIGGQMD...	QQLSSIMEGAL	LYMR	GTKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
OFQ30146.1/1-348	NLV	KP	PLVEGQSV...	QQLSSIMDGLT	LYMR	GTEAISAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_090444700.1/1-394	GL	DDP	PVITGRSENN...	RELSAFMDGNL	LYMR	GSKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_096347522.1/1-371	GL	QSP	EVTGGRTOIS...	VGSSGSAQVSDGSM	FL	LNKAIKAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_083700870.1/1-372	GIA	QAP	LVPSPSTVTS...	LLKEETIISDQNL	LYLR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE
WP_089358910.1/1-358	GY	DSP	QVTPGKTSV...	GDFAEFMDGNL	LYMR	GAKALAEAE	IKNLE	RRTSD	DFTEPRIADIQSELAMLENNRE

340 350 360 370 380 390 400 410
WP_103462906.1/1-459 VEAIKARVNDQDFLEGV EALRAERVRLQA I. NTELQGLQVLSIDQR AVAAAK PLKPRKALIVMFAFVC GLLGLV I IALVR
WP_104882382.1/1-434 MQSLEQRKND EFLFKGVEV LRAERSRLNA V. NTDLSGLRLVSV DQQATEP LS PVFPRKSVFISLGVIF GGVIGM V VYLLR
WP_088514052.1/1-496 VEVLKRRDND EFLFKGVEV LRAERVRLKES V. GADASSMR LVSIDQP AMAPVA PVQPKKLLVLAGLVV GVCVGI F LAIMR
KDN97867.1/1-468 VEVLKQRENE DFLFKGVEV LRAERVRLTNI I. GTDMQHL SLVNIDQR AIEPTS TRPKNKALLIALGLFI GLLGMV M VAIFR
WP_078479769.1/1-454 VEVLKRENE EFLFKGVEV LRAERIRLENI I. STDSQLRLVSI DRFAVE PVN VAPQKLLWIALGLIL GAGIGL F LAILR
WP_088851822.1/1-452 IEVLQRRKEDAL FVAGTSAK RTEQALLEAQ. DSTLAGLRLVEV EQP ALA SE PIKPMRLILISFGALL GVI VGI MAVLR
WP_009407565.1/1-451 VEGLKARLNE DFLFDNV QP LRAEAARLQS L. STDFSHVQLVSI DQR ALP SES PVKPRRALIVLAGLIS GLGLGL L VAFAR
WP_010224133.1/1-445 VQLLQNRQND EFLQNVDD VRKEMDRLLKN L. GIDFDNI KMVQIDRR AIESLO PVRPRAIILVAVLV GLLVGV V VAILR
WP_095155722.1/1-411 VEILKRRQND EFLFLGIEP MEKEMVRLKGL. NTDMQEL KMVLDVRS ALQSPA PIKPMKSLVVLGALL GALLGA V FVLLA
SEE98527.1/1-443 VEMLVNRTNE DFLFKYIEP LRAEAARLGS L. NTDMSRLGLVSI DRMAQTP TD PIKPKKALIVLGLVLF GLLVGL C IATAR
WP_088500293.1/1-447 VEQLGKRANE DFLVKNIEP LRAEIVRLGN L. NTDMSALGLVSI DRK AQT PVS ALKPKKALTIVLGLFL GLLGLG I ITTVR
WP_105696847.1/1-435 IEALNDRKKE DIFYAGVQP LRAEIVRLRS L. NVDLNMLKLVSLD QYALD PLA PVAPKKTIAVFGVLF GLMFGV V VYLLR
SEI23467.1/1-450 VQILQRRNNE DFLIDVQQFRAEITRLRN L. NINMGKVKLVSI DRALALEP SA PIKPKKAMIVSLAFIF GLVFGV L LVVLR
WP_083351555.1/1-458 VEVLNARENE DFLAGVQP LRAEMARLSS L. NIDMAGLKLVTVD QALP LV AASP NRLLVVLGGLL GAVLAL C IALLR
SDU95947.1/1-478 VEVLNKRNE DFLQDVQEP LRAEMARLGS L. NIDMSHLKLVTI DRRAQEP LS PVKPKKLVVVALSLVA GLVGLV L AAILR
WP_084378137.1/1-454 IEVLNAREKE DFLRDV EPLRAEEARLRN L. NLDISR IKLVTI DRV ALEP LE PVKPRKTLIVLGLVLL GFIVGL G GVVLR
WP_094988732.1/1-456 VEVLKQRQND EFLSGVEP LRAEVRLGN L. NLDFTNLKLVSI DRK ALEP MA PVKPKKSLIVVMGLLL GGMFGV F IALMR
WP_010224133.1/1-454 IEALQQRKLD DFLYQDIAS ITRAEVFELEQ. KLQASMLKLVSI DRQ AVSQA PASPNKLLVLAGLVA GLTLGF V VAILR
AHZ68776.1/1-435 V GALMERNE DFLFDGIGD ITRGDLTRLKN L. NINFDQFELVHIDKALEP LS PVYPKTKVVGGLGILF GLALGV F VAILR
WP_083368292.1/1-426 VEILKRRNE DFLFKGLS IREELARLKN L. NIDFQFELVHIDKALEP LS PVYPKTKVVGGLGILF GLALGV F VAILR
WP_070747362.1/1-442 VQYLQARKGE ERFFENIDK LRGEQARLKT L. KASEPKIE LVRI DQKASTP LK PIKPRKALVVALGLL G LALGV L VALVR
O13Wzz2/1-442 VQYLQARKGE ERFFENIDK LRGEQARLKT L. KASEPKIE LVRI DQKASTP LK PIKPRKALVVALGLL G LALGV L VALVR
WP_075933891.1/1-437 IE LLKQRAD E DFLYIENYAKWSQEAALKGL. NNLNSALQLVSI DRQ AVSQA PASPNKLLVLAGLVA GLTLGF V VAILR
WP_090231723.1/1-427 IEQLKQRDE DFLIGAYADWHKAAKLN L. NNLNLANLNVNI DQYAGAPYS PVKPRKALVVALGLL G LALGV L VALVR
WP_095626245.1/1-443 VEVLSSRKND EFLKRLARSREEQARLQA L. SVDFSNLKLVTI DRV ALEP LT PVGPRKLVVLAIGVLF GMLGMV F IALVR
WP_087516191.1/1-448 VEALRRHRGND DFLSKLAKWEEETS YLQEL. KPELLLLD LVDI DQPAVS PLS PIKPKKLLIVLGLVLF GMLGMV F IALVR
WP_007942594.1/1-445 IEQLKSRKND EFLFTTLV MRAEKSRL EHT. NRDLSELALVKVD QQA IKNK PIKPKKLLIVLGLVLF GMLGMV F IALVR
WP_003458426.1/1-427 IEILKQRND E DFLFKLVKLRGEQARLEN L. KVDFSRLKLVRI DQV ATAP QK PIKPRKALVVALGLL G LALGV L VALVR
WP_015478627.1/1-434 VEMLRGRAND EFLANLALTEQARLEHT. SVDFSQ LKLVLD QPAMTSG PVKPRKALVVALGLL G LALGV L VALVR
WP_074859164.1/1-427 IEMMQSRENE DFLAKLAKMREEAARLKS I. LNDLEQLKLVRI DQV A IKNK PIKPKKLLIVLGLVLF GMLGMV F IALVR
WP_093477159.1/1-432 IEMLQARENE DFLAE LAKLRSEARLKS I. ELDPQKLSLVRI DQV AVQ PVS AIKPKKPMIALGIVL GMLGM I IALMR
WP_095626167.1/1-430 VETLNSRENE DFLAE LAKLRSEARLKS I. SLEPEHLN LVRI DQV A IKNK PIKPKKALVVALGLVLF GLVGL IAVLVR
WP_095626245.1/1-424 IEVLSRENE DFLITELAE MRSERARLKS I. QNLNLEQLKLVRI DQV A IKNK PIKPKKALVVALGLVLF GLVGL IAVLVR
WP_102856965.1/1-423 VELMRQRD TD DFLADLANWRKEAHLKA L. DLDVEALKLVRLD QPAMTSG PVKPRKALVVALGLVLF GMLGM I FVALVR
WP_095601146.1/1-435 VEILKQRENE DFLSKLALWREEAARLRA L. NIDVSKLKVRI DQV AVEP SG PIKPKKLLIVLGLVLF GMLGM I FVALVR
WP_095601145.1/1-425 VELLKQRQDE DFLYKDLALWREEAARLKG I. KFDASGLQLVRI DQV ALEP LS RVKPKRALVVALGMV I GMLGL F VALLR
O13Wzz1/1-349 VEILKERES E DFLYLTN LALWREEAARLKG I. KLDTERLKLVRLD QP ALQSTD PVKPKKAMIALGLVLF GMLGM I FVALVR
WP_095943962.1/1-360 DFFTPGLRNL QKDVDFYK K L. ESEKFEI AAFRHDG VLDL PVS PVKPKKLVIVLGLVLF GMLGSS T ALLN
SNT23956.1/1-381 DAFIPELREV QTKQFYQMG L. VGAQRHV SVYQLDGT IEQPDV PIKPKKLLIVLGLVLF GMLGSS T ALLN
SDZ58113.1/1-345 DFFTDSLREHEARQYFYK L. MEFSPSRD SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_087092368.1/1-349 DFFITSLRQEAKYDLYRS L. MLFSPVGV SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_092197691.1/1-355 DAFITGLREL QAKKSFFEK L. AVTSPRI DMYRYMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_077747951.1/1-351 DFFIDGLREL QSRLEYFKG M. KVTPEIS SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_008049008.1/1-353 DFFISRLREIETKYNFYNO L. SKSYREAKAFRIDGLVEKSGS PVKPKKLLIVLGLVLF GMLGSS T ALLN
WP_079305324.1/1-357 DAFISNLRQLMRYNFYRML. NLDIPERISVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_057713773.1/1-356 DFFIQSLRVLQVKYLF LKN L. TIDSSV SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_007985394.1/1-344 DFFIGRLREL ESKRNFYK L. SSNLQDV SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_102700290.1/1-347 DFFTDRLREL QSKYNYFKG L. KTDAAA SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_095143914.1/1-353 DFFVTDLRLQLSKYDLYK L. EVNKPD SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_015093986.1/1-360 DFFIKKLRRLQAKYDFYK L. ESSILN SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
AVO60423.1/1-351 DFFIGRLREL QVKHDFYKGV. EVKAGD SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_102643277.1/1-351 DFFIANLRKLQGMNEFYK L. GVKAED SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_010224134.1/1-358 DFFINKLRDLQARYEFYAG L. EAEPGG SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_093460654.1/1-355 DFFIENLRDLQIKAGFYHG L. NVNPEV SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_012684334.1/1-353 DFFTPGLRVYQEELAFYQA L. KVGAEV SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_060492586.1/1-347 DFFIANLRQL EERMAFYRD L. KINEDAF SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_095155502.1/1-368 DFFIDGLRERQVELEFYSA L. KILPST IAVYRQDGA IGV DRS I LPSGVLVVVGSL GVVGV ASVLMW
WP_088851820.1/1-352 DSFIDGLRKRREGQIHFLRK L. NVASENLQVFRQDGGV ELP DA PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_014592020.1/1-350 DFFVNNLRREEQAAVYRS L. KVPSPDQ SVYRQDGV IEIET PIKPKKALVVALGMFA GLFLGI F IALVR
WP_060514541.1/1-353 DFFVADLRREVQEKLDYFRN L. TLNAAE IVEVFRQDGA IEV DS VRLRKLIVMGGAFAG LVLGV L LASFT
WP_011532778.1/1-346 DFFISNLRQREAEVSFYRS L. RIDPAL IVEVFRQDGD L IVP DR VSPKSLVLLIALCL GLAAGA C LALAR
WP_069942143.1/1-352 DFFVDHLRRDQETIAFYET L. EIDPSV IVEVFRQDGGV L YADK PVKPKKSLIVLGLVLF GMLGSS T ALLN
WP_028698674.1/1-358 DAFIDGLRRRQERLAFYRG L. KVDPQS VVFRQDGGV ELP DK PVKPRRALIVTAAVLV GLAVGV L VAIMR
WP_058541039.1/1-356 DFFIQNLRDQQAALTYFRN L. SIDPAL VVFRQDGGV ELP DK PVKPKKLLIVLGLVLF GMLGSS T ALLN
WP_090225885.1/1-350 DFFIESLRDLQEEKALFGLG L. RM. PDTMRTVQV DQV ALLP DA PVKPRALVLLVLAALLI GLIAGT L LASV L
OFQ79174.1/1-345 AFFIPELRLQEKLSWNS L. SVDSAV VVYKDEGLSFSNQ PIKPKKLLIVTIGTLAG L IIGI L LAVLA
WP_070581731.1/1-344 DSFIDGLRALQERYALYTK L. SPDESQ SVYRMDG V IKNP AAR PIKPKKLLIVLGLVLF GMLGSS T ALLN
O13Wzz1/1-349 DFFIPALRLQEKQAMYST L. KLDVNK SVVFRQDGGV ELP DD PVRPCKKLLVLAGLV GVLWGM IAFIV
OFQ30146.1/1-348 DFFIPQLRGLLEERYKLYEN M. SLPVQR IAVFRQDGA VEI PDV PVKPKKVMIVLGLVLF GMLGSS T ALLN
WP_090444700.1/1-394 DFFIPDLRNLLEEKYKLYAN V. KLDPERV VVFRQDGGV ELP DD PIKPKKLLIVLGLVLF GMLGSS T ALLN
WP_096347522.1/1-371 DFFISELRDIQKQIAMNLV L. DPIPEFVQLFTLDSVAE VSEN PVKPKKANIVMIGITV GGLAGL V VALFR
WP_083700870.1/1-372 DFFIPELRLRTQLAFLKS I. DVQPDNVAVFTLDRVAE P EL PANLRKSLIVIGLGA GVLGV F AGLVR
WP_089358910.1/1-358 DFFIIVELRGENQMDFLQK I. DVNPDNVAVFTLDRVAE P EL TAPKLLVLAGLV GVLGGLV F IAFIR

	4 2 0	4 3 0	4 4 0	4 5 0																											
WP_103462906.1/1-459	AAFKNNLRRMR	TA	EVGGAVAVVLP	EDLSR.....QVNVLLPEAQIGAAKK...																											
WP_104882382.1/1-434	HALKSRRLDEL	LR	ETILVKNVI	.GSEVI.....APLPSTAQ.....																											
WP_088514052.1/1-496	NLLVRRRLHLS	Q	EVSMAPVVAKT	.QA.....PSLPESGR.....																											
KDN97867.1/1-468	HFMVLRMRERS	SAPQALSQ	VI	NEPS.....QSIKGPSTSNVL.....																											
WP_078479769.1/1-454	NAVHTRRRGS	Q	TQA	AKPHSVA..ADAR.....SSLPAL.....																											
WP_088851822.1/1-452	RYIALRSV	PFTSDR	PKIVEASIQ	ALK.....AVD.....																											
WP_009407565.1/1-451	YQVQCMRTR	SLRSALPRV	LEAQ	.DPLL.....RPAETVRIE..																											
WP_010224133.1/1-445	HYALQQASL	AVGRQVEQ	...TE	.RALERRTKGD.ALRETL.....																											
WP_095155722.1/1-411	RYMTLRRS	AMAIH																											
SEE98527.1/1-443	YLI	NR	RKQAL																											
WP_088500293.1/1-447	YFN	VRRRDEL	KQSS																											
WP_105696847.1/1-435	HLM	LSRLP	STTGLTQ	VAVDS...LS.....VASEINRSPNSCRTEPS																											
SEI23467.1/1-450	QLI	FLKHRSHV	AEIAPV	SVL.....PEESDSLMLR.....																											
WP_083351555.1/1-458	SAI	IVASRD	..I	IKERSPGSQVS.RLNARGHIGE.LPDQQHSIQ..PIQK.....																											
SDU95947.1/1-478	HFV	LARHA	...TPPY	SPLVDDR.FSRRERKDD.EPLV.....																											
WP_084378137.1/1-454	QLF	LLKKE	..G	GENFSHSVAPA..MME...GD...VTNALPRSPSDRG.....																											
WP_094988732.1/1-456	YLV	KSHRL	..Q	QRLSPVLS.A.TLS...GA.QGVVSGNGKVLQSDRR.....																											
WP_102684332.1/1-464	HLF	MSNASQ	FKGTAFDR	VESPGAVLRREDLSGG.RL.....R.....																											
AHZ68776.1/1-435	RLF	QSFQATP	H																											
WP_083368292.1/1-426	I	V	M	FPKRRVQD.....																											
WP_070747362.1/1-442	AM	L	R	APRQVRQENSLPPG...VVSLDRSLSGT.....																											
O13Wzz2/1-442	AM	L	R	TPRQVRQEDSLPPG...VVSLDRSLSGT.....																											
WP_075933891.1/1-437	FF	L	N	ETGGRASLKYREG..I..EKAQL.....																											
WP_090231723.1/1-427	I	L	V	SSSRKN.....																											
WP_058067976.1/1-443	A	F	L	RQTPQAKVLISFEPKP..ELVDLPRAVVG.....																											
WP_087516191.1/1-448	S	M	M	TRLKPI	SLTMLNPLPV..EHAGH..KLVQQ.....																										
WP_007942594.1/1-445	G	M	V	L	SRSASPYEVSTEKV...FIGQ..STLQ.....																										
WP_003458269.1/1-427	V	M	V	L	RQVRVGTAV.....																										
WP_015478627.1/1-434	V	V	R	G	QPIVREERALVLN...YSS.....																										
WP_074859164.1/1-427	I	V	F	T	GNRTRSA.....																										
WP_093477159.1/1-432	I	V	I	R	KRQAEKPA.....																										
WP_095626167.1/1-430	I	A	L	S	SRRARAGTAVSL.....																										
WP_095626245.1/1-424	I	A	M	R	SRKSI	AKPTSEA.....																									
WP_102856965.1/1-423	A	L	L	M	SNSRVQPI.....																										
WP_095601146.1/1-435	N	I	V	R	RKPD	TFAILR.....																									
WP_095601145.1/1-425	N	L	L	R	R	GEPGVAVPA.....																									
WP_102851015.1/1-435	S	L	V	N	R	S	D	T	H	P	V	Y	K																	
WP_095943962.1/1-360	H	F	I	T	K	R	R	D	A	D	E	S	T	V	Q	V	V	N	.HR	L									
SNT23956.1/1-381	Y	A	M	Q	N	L	Q	R	R	R	A	C	P	K	N	E														
SDS58113.1/1-345	A	S	L	R	I	L	F	R	K	V																				
WP_087092368.1/1-349	D	F	L	R	A	S																								
WP_092197691.1/1-355	H	H	L	G	G	K	R	A	K	K	S	R	V	H	Q	V														
WP_077747951.1/1-351	V	F	I	A	K	G	R	A	R	A	L	S																		
WP_008049008.1/1-353	D	F	F	M	T	N	K	V	G	I	Q	K	T	L																
WP_079305324.1/1-357	F	V	L	S	R	N	Q	G	A	W	R	G	.G	E	V	G	R	.G												
WP_057713773.1/1-356	Y	F	K	P	L	L	R	A	K	I	L	V	P	S	S	H	T													
WP_007985394.1/1-344	Y	F	L	S	S	N	S	K	R	S	V	F	S	Q																
WP_102700290.1/1-347	G	F	F	A	A	K	S	E	D																					
WP_095143914.1/1-353	Y	L	L	D	K	K	H	S	T	P	R	P	L	A																
WP_015093986.1/1-360	N	Y	L	S	S	D	G	V	R	L	F	E	S	R	S	V	A	K	.NR	Q									
AVO60423.1/1-351	V	Y	L	M	S	R	G	R	S	V	A	P	S																	
WP_102643277.1/1-351	H	F	W	T	V	R	K	P	E																					
WP_010224134.1/1-358	A	L	I	K	R	V	D	P	R	S	P	H	A	S	G	A	L													
WP_093460654.1/1-355	Y	V	V	R	R	F	R	T	A	K	R	I	D	P	S	Q	L													
WP_102684334.1/1-353	L	V	W	R	G	V	.R	R	R	G	S	S	A	A	E	.L	S	SS											
WP_060492586.1/1-347	F	F	V	R	G	K	.K	A	R	F	A																			
WP_095155502.1/1-368	Y	L	I	S	V	A	F	L	...S	P	D	N	G	N	H	GK	R	R	R	H	G	G	G	D	S	G	Q	V	L
WP_088851820.1/1-352	Y	L	R	G	N	L	H	R	F	R	C	K	S	E																
WP_014592020.1/1-350	E	A	W	R	F	R	.Q	A	R	L	R	T																		
WP_060514541.1/1-353	H	L	V	S	A	E	.R	M	R	R	L	K	R	A																
WP_011532778.1/1-346	H	G	W	V	R	R	.T	V	V	S	K																			
WP_069942143.1/1-352	A	F	F	V	V	R	.R	F	A	A	G	V	R																	
WP_028698674.1/1-358	D	L	L	Q	R	R	.R	.K	P	A	A	L	S	R	V	I	GN	E											
WP_058541039.1/1-356	H	L	F	R	Q	A	.L	R	Q	R	P	S	S	L	A	G	T													
WP_090225885.1/1-350	G	A	T	M	R	K	G	E	A	R																				
OFQ79174.1/1-345	G	F	I	R	K	L	R	S	D	G	S	L	R																	
WP_070581731.1/1-344	I	V	Q	F	R	R																								
O13Wzz1/1-349	M	A	V	R	R	S	R	A	K																					
OFQ30146.1/1-348	H	V	L	R	K	S	R	V	S																					
WP_090444700.1/1-394	L	M	L	K	K	R	L	P	H	S																				
WP_096347522.1/1-371	A	A	I	R	R	R	K	H	E	V	Q	T	G	E	R															
WP_083700870.1/1-372	G	L	V	R	R	R	L	L	A	A	Q	A	D	S	E	M	T	A	.HA	.A	S	A	G	G	A				
WP_089358910.1/1-358	M	F	E	I	N	R	T	D																						

Figure S3 Multiple sequence alignment of Wzz₁ and Wzz₂ homologs. The alignment shows two clear protein groups. The group containing Wzz₂ (sequences coloured red) has several insertions and deletions compared to the group containing Wzz₁ (sequences

coloured blue). Figure is continued from previous six pages. Identical residues are coloured white with a red background and residues with a similarity score > 0.7 are coloured red with a white background.

1 10 20 30 40 50 60
 O13Wzz2 MPSSQLPGASPSEI **D**IVQLFQQ **L**WAS **K**WLI **I**ALIAALAT **A**AALAYALL **A**VPT **Y**QVDVL **L**RP

70 80 90 100 110 120
 O13Wzz2 IQTKA **L**EAVN **V**KGLYAL **T**PRE **A**LD **R**VGNELAA **Y**SG **R**LE **V**FETHPEL **F**QQLNAEGL **S**PEQA

130 140 150 160 170 180
 O13Wzz2 FWKF **N**QDA **F**S **M**QQADL **K**KDPQA **A**PF **F**RL **S**MQ **Y**PQ **G**MD **G**AA **I**NGM **L**AST **I**ENE **R**QR **I**LD **D**

Ins_{IL}

190 200 210 220 230 240
 O13Wzz2 LQAR **I**DG **R**I **Q**F **L**EQD **I**E **G**K **R**AS **Q**AT **K**EG **K** **I**AR **L**L **E**ADS **I**RRAG **E**DEL **K**AL **R**GR **I**K **M**V **R**

Ins_{α6}

250 260 270 280 290 300
 O13Wzz2 DS **R**I **Q**Q **L**N **E**AI **Q** **I**ATR **L**GI **V**K **T**TP **G**AL **G**EV **G**Q **D**GS **R** **S**V **F** **R**TE **V**NN **Q**Q **I** **P**LY **F** **M**C **V**D **S**T

Ins_{L4}

310 320 330 340 350 360
 O13Wzz2 **A**ER **D**T **L**L **K** **K**G **D**D **F**TE **P**RV **A**K **I**R **Q**E **F** **K**Q **L**EN **N**RE **V**Q **Y** **L**QA **R** **K**G **E**ER **F**FEN **I**DK **L**R **G**E **Q**AR

Ins_{α7}

370 380 390 400 410 420
 O13Wzz2 **L**KT **L**KASE **P**K **I**E **L**VR **I**D **Q**K **A**ST **P**L **K**P **I**K **P**R **K**AL **V**V **A**LC **L**L **G**L **V**FG **V**LV **A**L **V**R **A**ML **R**T **P**R

430 440
 O13Wzz2 QRVQEDSLPPGVVSLDRSLSGT

Figure S4 Conserved residues of Wzz₂ targeted for site directed mutagenesis. The residues targeted are indicated by the black arrows. Residues are coloured as follows: red box with white text, completely conserved amongst the Wzz₂ group; blue box with red text, similarity score > 0.9 amongst the Wzz₂ group.

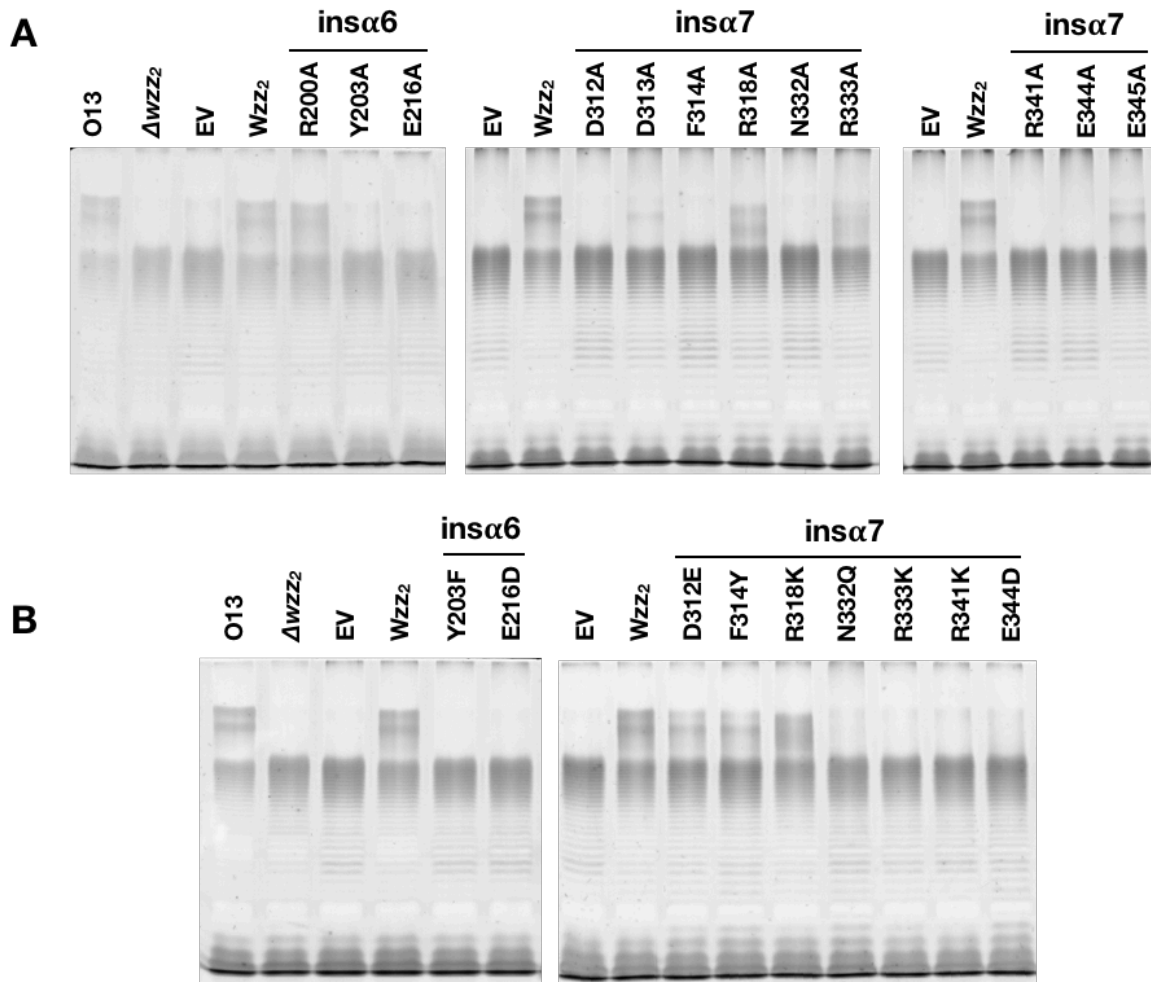


Figure S5 Chain length phenotypes conferred by *Wzz₂* variants when expressed at basal levels. A) Alanine variants R318A and R333A alter the banding pattern while Y203A, E216A, D312A, F314A, R318A, N332A, R341A, and E344A abolishes chain length control. B) Like-amino acid switches D312E and F314Y are the only variants that restore very long OSA production to wildtype lengths. The R318K variant produces very long OSA that is shorter than the wildtype.

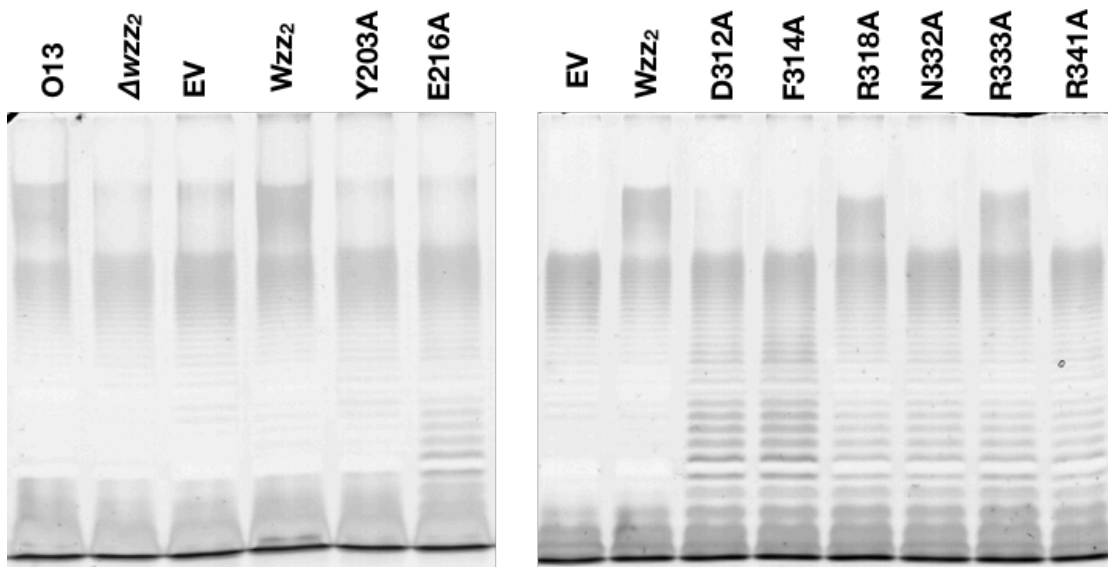


Figure S6 Silver-stained SDS-PAGE gel of FLAG-tagged Wzz₂ single amino acid mutants. Bacteria containing each plasmid were cultured in the presence of 0.1% L-arabinose. The LPS profiles are indistinguishable from the corresponding untagged mutant proteins (Fig. 5A).

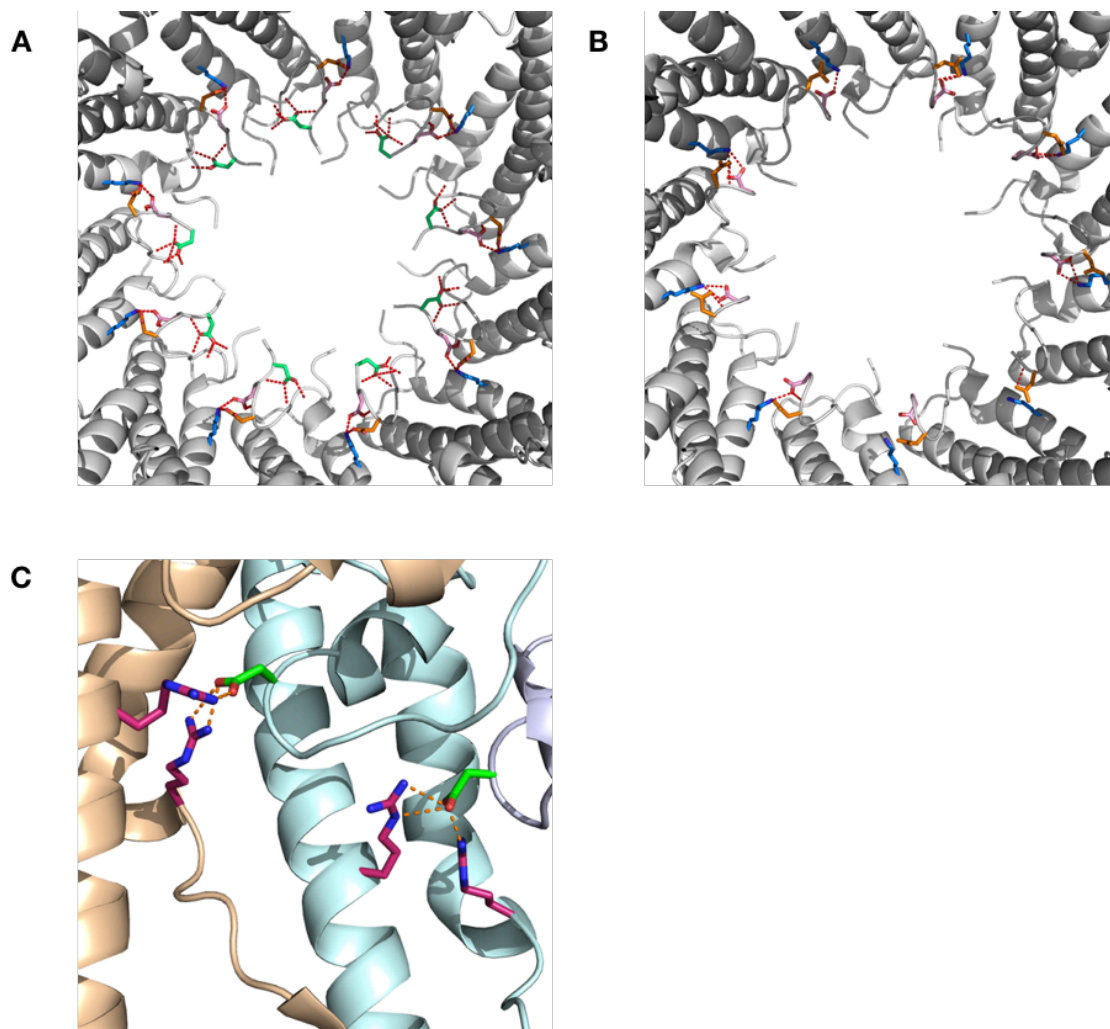


Figure S7 Loop 4 interacts with residues of the α -helical domain. The loop regions of the experimentally determined structures of A) FepE (PDB ID: 3B8M) and B) FepE Δ 258:266::GSG (PDB ID: 4E2L) are viewed from within the cavity of Wzz and looking towards the top of the oligomer. Residues D265, D266, D268, and K281 are shown in green, pink, orange, and blue, respectively. For clarity, only the side chains of these residues are shown. In the wildtype FepE protein, these residues are predicted to engage in more polar contacts (red dashed lines) than the mutant. C) D226 of WzzB_{SF} (PDB ID: 4ZM1) forms potential salt bridges with R196 and R246. Three separate

protomers are shown in beige, blue, and purple. D226 is shown in green and R196 and R246 is shown in red.

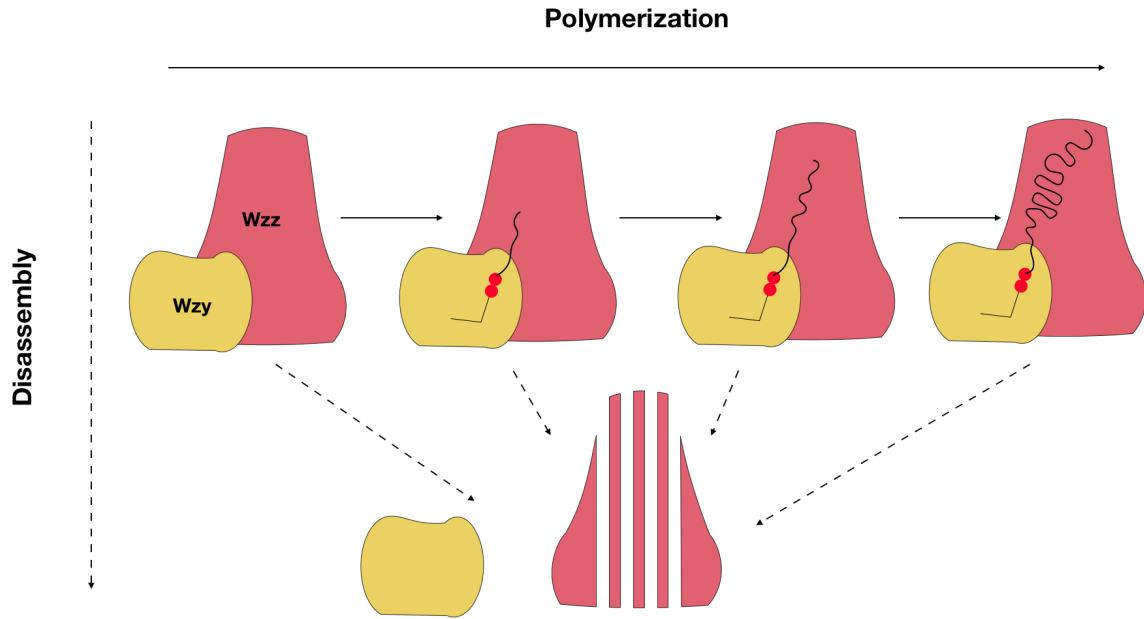


Figure S8 Model of Wzz-mediated chain length regulation. As the O antigen chain is polymerized by Wzy, the polysaccharide enters the cavity of Wzz, which exerts a force that promotes Wzz disassembly (dashed arrows). If the Wzz oligomer is stabilized by strong inter-/intra-protomer interactions, interactions with the polysaccharide, or interactions with Wzy, polymerization into the cavity proceeds for more rounds of polymerization (solid line). When the maximum internal capacity of Wzz has been filled, the complex disassembles.